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THE PHILIPPINE PHALLOSTETHIDÆ, A DESCRIPTION OF A NEW SPECIES, AND A REPORT ON THE BIOLOGY OF *GULAPHALLUS MIRABILIS* HERRE.¹

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FIVE PLATES AND THREE TEXT FIGURES

Herre (1925) erected the genus *Gulaphallus* (family Phallostethidæ) to accommodate two strange new fishes collected from the fresh-water mountain streams of central Luzon. These are *Gulaphallus eximius* and *G. mirabilis*. A year later the same author described another phallostethid, *Mirophallus bikolanus*, from specimens obtained from the fresh-water lakes of southern Luzon.

The writers now report another species of Phallostethidæ, *Gulaphallus amaricola* sp. nov., collected from the brackish water² about Manila Bay. Of the known species of Phallostethidæ this new form is the first that is not an inhabitant of fresh water. The presence of the spinous dorsal fin and the absence

¹ Data relating to the life history and habits of *Gulaphallus mirabilis* Herre were included in an undergraduate thesis presented for graduation in 1932, by Porfirio R. Manacop, for the degree of Bachelor of Agriculture, prepared in the Department of Entomology, College of Agriculture, University of the Philippines, under the direction of Dr. Deogracias V. Villadolid.

² Materials were obtained in two collections from the brackish sloughs near Fort San Antonio Abad, Manila Bay, in the neighborhood of Pasay, Rizal. The first collection was made by Drs. C. G. Manuel and D. V. Villadolid in the summer of 1927, and the second by the former in the summer of 1932.

of scales on the nape and opercles, place the animal in the genus *Gulaphallus*.

GULAPHALLUS AMARICOLA sp. nov. Plate 1, figs. 1, 1a, 2, 2a.

First dorsal, II; second dorsal, I, 4-5 (usually I, 4); anal, I, 14-16 (mostly I, 14). Scales in median lateral series 30 to 32 (counted from gill opening to base of caudal fin); scales from origin of second dorsal to anal, 5; scales from first dorsal to naked region of nape, 17 to 19. Head, nape, and opercle, naked. Dorsal profile slightly elevated, but ventral strongly convex in females.

Myotomes very evident; a fine median dark line on sides extending from upper lid of pectoral fin to caudal base; occiput black. A line of dark chromatophores runs along base of abdominal fringe and anal fin to caudal peduncle. Scales along mid-dorsal line heavily lined with black chromatophores. Scales regularly arranged along lateral line.

Male (Plate 1, figs. 1, 1a).—Body strongly compressed and slender, gradually tapering posteriorly. Sexually mature fish vary from 2.0 to 2.5 centimeters in length. Dorsal fins placed far back, the first above the posterior half of anal, the second originating just above end of anal base. Depth 5.24 in length of body; head with pointed and projecting chin, and 7.24 in length of body; mouth small and nearly vertical, with two rows of fine, pointed teeth in each jaw. Teeth of outer row of upper jaw much larger and more regularly arranged than either the inner row or the teeth of lower jaw. Teeth of outer row of upper jaw become finer towards median line. Interorbital space flat and broader than eye diameter. Pectoral bases muscular; length of caudal fin about 1.5 times its depth. Priapium elongated and projecting slightly downwards. Two priapial appendages present. One of the ctenactinia is so markedly short and small that a casual observer might not notice its presence. It arises from the posterolateral side of the priapium just beneath the greatest curvature of the proximal end of the other, longer priapial appendage. This position makes it appear homologous with the ctenactinium of *Phenacostethus smithi* Myers (1928).

Posterior border of priapium lined with comblike (or finlike) projections which appear similar to those of *Neostethus lankesteri* Regan.

Pulvinulus shieldlike, smaller than eye, facing the side towards which appendages of priapium project. Vas deferens coiled

within posterior end of priapium, opening at tip of a curved end adjacent to the short ctenactinium. This bone, in all likelihood, guides the penislike structure during the act of copulation as in the case of *G. mirabilis*.

Female (Plate 1, figs. 2, 2a).—Similar to male except in the following: (a) Absence of priapial structure, (b) marked convexity of ventral region, (c) two tuftlike papillæ on each side of abdomen just below muscular base of pectoral fin, possibly vestiges of ventral fins. Regions around genital opening elevated; genital opening located ventrally along median line just below base of pectoral fins and posterior to anal opening. A membranous abdominal fringe extends from the groove below genital opening to base of anal fin.

Amaricola, a brackish-water inhabitant.

The above description is based on 127 specimens, 64 males and 63 females, all collected from the sloughs of Manila Bay in the neighborhood of Pasay, Rizal, Philippine Islands.

Types.—One male and one female in the zoölogical museum, College of Agriculture, University of the Philippines. Cotypes are also in the zoölogical museum.

Type locality.—Pasay, Rizal Province, Luzon Island, Philippine Islands.

On the average, *G. amaricola* is smaller than the other species of the Philippine phallostethids. Sexually mature specimens measure only 2.16 centimeters in length.

The taxonomic characters that justify the separation of *Gulaphallus amaricola* from the other known species of the genus are shown in the following table.

Characters.	<i>G. amaricola</i> .	<i>G. mirabilis</i> .	<i>G. ezimius</i> .
Second dorsal.....	I, 4 (rarely I, 5)....	I, 6.....	I, 6.
Anal.....	I, 14-16.....	I, 16 or 17.....	I, 14-16.
Pulvinulus.....	Present.....	Absent.....	Absent.
Scales in longitudinal series	30-32.....	36-38.....	56-58.
Scales, origin of 2d dorsal to hind end of anal.	5.....	9.....	14.
Predorsal scales.....	17-19.....	26.....	28.
Comblike projections at base of priapium.	Present.....	Absent.....	Absent.
Priapial appendage.....	Two ctenactinia, one very short, almost vestigial and pin- like.	Two ctenactinia, one slightly shorter and clawlike.	Two ctenactinia, one slightly shorter and hook- like but broad.

The number of scales in a lateral series in *G. mirabilis* was reported by Herre to be 36 to 38 from the type locality (Mount Ibo Creek, Bulacan). Our count from specimens collected from Molawin Creek, Laguna, showed, however, that the range was 32 to 35. This apparently overlaps to a slight extent the range of scales of *G. amaricola*, which is 30 to 32. However, *G. amaricola* cannot be identical with *G. mirabilis* of Molawin Creek because of the differences shown in the key below, and from the difference in the number of scales as follows:

	<i>G. mirabilis.</i>	<i>G. amaricola.</i>
Origin of 2d dorsal to end of anal	7	5
Origin of 2d dorsal to origin of anal	12	10
First dorsal to head	27-29	17-19

THE PHILIPPINE PHALLOSTETHIDÆ

The family Phallostethidæ comprises a group of fishes unique among the entire vertebrate fraternity. So far they are the only vertebrates which present structures not recognized until the discovery in 1913 by C. Tate Regan of one of its members, *Phallostethus dunckeri* from Johore, Malay Peninsula. Myers (1928) describes the unique characteristics of the Phallostethidæ as follows: "Pelvic fins reported as vestigial in the female and absent in the male, whilst below the head and throat of the latter was a most peculiar appendage containing the coiled vas deferens and the end of the intestine, together with a complicated skeletal system mostly of what appeared to be entirely new elements. This appendage, called by Regan the priapium, bore externally two long curved bones apparently used as clasping organs. These are the toxactinium and ctenactinium of his (Regan's) descriptions."

Dr. Carl L. Hubbs, in a letter to the senior author dated June 16, 1931, expressed the opinion that it is possible that the family Phallostethidæ to which *Gulaphallus mirabilis* Herre belongs is phylogenetically more nearly related to Percesoces than to Cyprinodontes. In the latter order the family Phallostethidæ is generally included. He says in part: "... A point that struck my attention was the mention that you had found that the eggs were attached by long filaments. This discovery confirms, though it can hardly be said to prove, Myers's contention that the Phallostethidæ are derivatives of the Percesoces rather than of the Cyprinodontes which lack egg filaments. Such filaments are developed in all Atherinidæ, so far as known, except in *Leuresthes*."

To date the known Philippine representatives of *Phallostethidæ* are only four and may be identified by the use of the following artificial key:

- a*¹. Spinous dorsal present; nape and opercles naked.
 - b*¹. Comblike projections from base of priapium present (in males). Inhabitant of brackish-water. Scales 30 to 32 in lateral series.

Gulaphallus amaricola sp. nov.
 - b*². Comblike projections from base of priapium (in males) absent. Inhabitant of fresh-water streams.
 - c*¹. Scales 56 to 58 in lateral series..... *Gulaphallus eximius* Herre.
 - c*². Scales 36 to 38 lateral series..... *Gulaphallus mirabilis* Herre.
- a*². No spinous dorsal; nape and opercles scaly; scales 32 in lateral series. Inhabitant of fresh-water lakes..... *Mirophallus bikolanus* Herre.

Distribution of Philippine phallostethids.—With the exception of *G. amaricola* sp. nov. all the known members of the family *Phallostethidæ* are inhabitants of fresh-water bodies; *G. amaricola* is an inhabitant of the brackish water of the sloughs about Manila Bay.

Gulaphallus mirabilis Herre was originally reported and described from Ibo Creek, a tributary of Angat River, Bulacan Province, Luzon. This river empties into Manila Bay. This species is also found in large numbers in Molawin Creek, Laguna, which originates in Mount Maquiling, and, like Angat River, empties into Manila Bay, through Laguna de Bay and Pasig River.

Gulaphallus eximius Herre was originally described from specimens collected from a mountain stream at Santa Fe, Nueva Vizcaya Province, Luzon. This stream is a branch of Magat River emptying into the main stream, Cagayan River, which in turn empties into the open sea in the northern part of Luzon.

Mirophallus bikolanus Herre was described from specimens collected from Lake Bato, Camarines Sur, and from Lake Lanigay, Albay. Both of these provinces are in the southern part of Luzon. Both Lake Bato and Lake Lanigay are connected with tributaries of Bicol River which empties into San Miguel Bay of the China Sea.

Distribution of Gulaphallus mirabilis in Molawin Creek.—Surveys April 7 and 8, 1931, along Molawin Creek, showed that the fish occurred from within a kilometer from the mouth up to an elevation of about 70 meters. The absence of *Gulaphallus* beyond this altitude may be due to the presence in that part of the creek of a waterfall which is about 3 meters high. The absence of *Gulaphallus* at the mouth of Molawin Creek was due

probably to the water being shallow. The depth of the water was found to be about 30 centimeters, and the fish apparently avoids very shallow water. Observations on the habitat of *Gulaphallus* in Molawin Creek showed that they prefer deep, shaded, and quiet places. Another survey of the creek was made November 22, 1931, when the water of Laguna de Bay was at high tide. *Gulaphallus* was found at the mouth of the creek. The water at that time was about 1.5 meters deep.

It is not improbable that some of the *Gulaphallus* may be carried into Laguna de Bay by floods. Nevertheless, a great number apparently manage to remain in the creek, as shown by the fact that just after a flood collections made in the creek still yielded plenty of specimens. The fish probably take refuge in back eddies where the current is not strong enough to carry them along during the flood.

BREEDING HABITS

(a) *Manner of oviposition.*—Observations on the breeding habits of *G. mirabilis* were made in a glass aquarium of about 30 liters capacity, in which *Ceratophyllum demersum* Linnæus was kept. The bottom of the aquarium was covered with a thin layer of sand and gravel from Molawin Creek.

Four females carrying ripe eggs and two adult males were transferred into the aquarium. September 15, 1931, at about 8 a. m., one of the four females was observed swimming up and down the aquarium. Soon two to three eggs were seen arranged in a linear series in its oviduct. After a few minutes the fish was observed swimming slowly in a dorsolateral position, and then it rested close to a healthy stem of *Ceratophyllum*. This was followed by the vibration of the caudal half of the body and the subsequent jerky motion of the whole body followed by the extrusion of the eggs. As soon as each egg was extruded it attached itself automatically to the leaves or stems of *Ceratophyllum* by its adhesive threadlike processes. The eggs apparently did not receive parental care after oviposition.

(b) *Copulation* (Plate 5, fig. 2).—Five mature females and three mature males were placed in a balanced aquarium in the laboratory. Copulation was observed to occur at any time of the day throughout the breeding season.

Prior to copulation, the male usually darts around a female and snappily grips her with its toxactinium. When the male fails to grasp the female, he chases her. Sometimes he is interrupted

TABLE 1.—The average monthly diameter frequencies of ova of *Gulaphalus* during the spawning period. (Ova were taken from ten fishes at intervals of fourteen days.)

Egg diameter. mm.	Diameter frequency.											
	1930		1931									
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.
0.025-0.07	19	24	23	23	30	30	34	33	38	23	16	26
.071-.08	73	62	61	69	62	72	85	73	62	79	65	67
.081-.09	29	28	25	24	14	11	8	12	14	10	9	28
.091-.10	13	18	20	21	19	18	12	26	22	28	35	26
.101-.11	11	19	18	14	12	9	8	11	12	26	23	23
.111-.12	15	14	20	14	15	19	15	19	12	14	19	24
.121-.13	14	12	15	13	12	12	9	17	15	6	15	22
.131-.14	9	10	13	16	16	6	13	14	8	5	9	10
.141-.15	13	12	11	12	14	12	11	9	11	9	6	8
.151-.16	9	8	9	7	14	9	7	0	7	5	2	3
.161-.17	8	9	7	8	6	8	7	2	5	4	3	4
.171-.18	7	8	6	10	7	10	3	0	7	4	8	3
.181-.19	12	7	7	9	10	7	9	9	8	8	9	0
.191-.24	9	10	4	9	8	9	5	11	9	7	10	3
.241-.29	6	8	10	8	9	7	11	4	8	6	8	2
.291-.34	10	10	8	6	10	12	8	10	8	5	4	4
.341-.39	10	8	9	7	9	11	7	8	8	8	8	2
.391-.44	9	5	8	5	7	8	8	13	11	10	11	8
.441-.49	6	8	6	5	6	8	7	1	9	14	8	6
.491-.54	4	5	4	3	4	3	5	2	5	6	6	7
.541-.59	5	3	2	3	4	2	3	1	4	6	7	5
.591-.64	3	2	3	2	1	2	5	0	2	3	4	4
.641-.69	1	1	1	2	1	3	4	3	3	2	3	3
.691-.74	1	0	0	2	0	2	3	5	2	3	2	2
.741-.79	0	0	1	0	2	4	3	5	1	3	4	1
.791-.84	0	1	1	0	2	2	1	4	0	1	0	3
.841-.89	2	3	2	1	0	0	0	0	1	0	0	0
.891-.94	0	1	1	3	1	0	1	4	1	2	2	0
.941-.99	2	1	2	2	2	2	3	2	2	1	1	4
.991-1.04	2	3	3	2	3	2	5	2	5	2	3	2
Total.	300	300	300	300	300	300	300	300	300	300	300	300

by a rival. It was observed that the victorious male drives away the vanquished. Some females were observed to approach males or swim around them at the time trying to flash their silvery white bellies. This behavior of the female probably attracts the males during the breeding season when the female is laden with ripe eggs. Newman (1906-1907) observed a similar behavior in *Fundulus majalis* Linnæus, where the females laden with ripe eggs frequently displayed themselves by

turning on the sides of the males near the bottom, spurning them with their tails, and causing their silvery white bellies to flash in the light.

During copulation the female *Gulaphallus mirabilis* lies on the aproctal side (either left or right) of her mate, depending upon the position of the toxactinium of the male. The toxactinium which curves toward the aproctal side grips the female under the chin and across the back part of the head, while the ctenactinium takes a firm hold on the pectoral region in front and on the side of the genital orifice until the penislike structure is introduced into the orifice.

While in this position, the pair swims about the aquarium. It may be assumed that during this time the sperm is discharged into the oviduct. The discharge of the sperm into the oviduct and its storage there are shown by the presence of active sperm in this region of a female that has just undergone copulation. Thus copulation in *Gulaphallus mirabilis* is apparently intromittent. The eggs are probably fertilized as they pass out through the oviduct, as may be judged from the fact that freshly extruded eggs when cultured in water free from sperm have been found to develop and hatch.

Copulation was observed in the aquarium to last for from one to two minutes. Copulating pairs have been observed to separate at once when disturbed by the other fishes. Sometimes the female struggled as if trying to separate from her mate.

SPAWNING SEASON

(a) *Condition of the ovary during the spawning season.*—A spawning female has three classes of eggs in the ovary. These are:

1. The immature eggs (group I) (Plate 2, fig. 1) measure from 25 μ to 129 μ in diameter. This group is represented by the largest number of eggs, the mode of which was found to be 0.07 millimeter for the three groups of eggs. This group is very transparent and appears slightly creamy when preserved in 10 per cent formalin solution, and is not visible to the naked eye. This kind of eggs is present in sexually mature females at all times throughout the year.

2. The intermediate eggs (group II) (Plate 2, fig. 2) measure from 130 μ to 410 μ in diameter. The eggs are creamy white and opaque with threadlike processes wound tightly around them in a labyrinthine manner. The presence of this class of eggs

in a female may be regarded as an indication of approaching maturity.

The immature and intermediate classes of eggs were readily separated from the maturing ova (group III) as the immature and intermediate classes were still bound together by the connective tissue of the ovary, while the maturing eggs (group III) were either free or loosely attached by the same tissue.

3. The maturing eggs (group III) (Plate 2, fig. 3) measure from 0.411 to 1.03 millimeters in diameter. The eggs are orange, translucent rather than opaque, and the threadlike processes have loosened up. When the size limit of about 1 millimeter is reached, the egg is expelled and deposited.

The ovary of the spawning female during the spawning season is very much distended, occupying almost one-fourth of the abdominal cavity (Plate 3, fig. 3). During the spawning period, however, some adult females were found with only immature and intermediate groups of eggs. This indicates that either the fish had not yet developed the maturing eggs or the maturing group of eggs has just been spawned.

(b) *Time of spawning.*—The spawning season was determined by collection and measurement of ova at intervals of fourteen days from November, 1930, to October, 1931. It was found that the fish spawns throughout the year, as spawning individuals could be found at all times during the year (fig. 1). During the course of this study mature eggs could be secured at any time for embryological study.

Fig. 1 is a summary of diameter frequencies of ova measured at intervals of fourteen days. Each curve represents the average of two measurements a month of 300 ova taken from ten fishes selected at random at each inspection.

The frequency curves in fig. 1 further lead to the following interpretations: (a) The rate at which the intermediate class of ova are derived from the immature group by the process of development and growth is slow and gradual. (b) This is also true within the transformation of the intermediate class into the maturing class of ova. This assumption is reinforced by the fact that spawning females have been repeatedly observed to contain only a few maturing ova at a time, the number varying from five to thirty, depending upon the size of the female. The sudden drop in fig. 1 of the frequency curves from the mode confirms the foregoing conclusions. With the exception of a few small, and probably insignificant, fluctuations, the remainder of

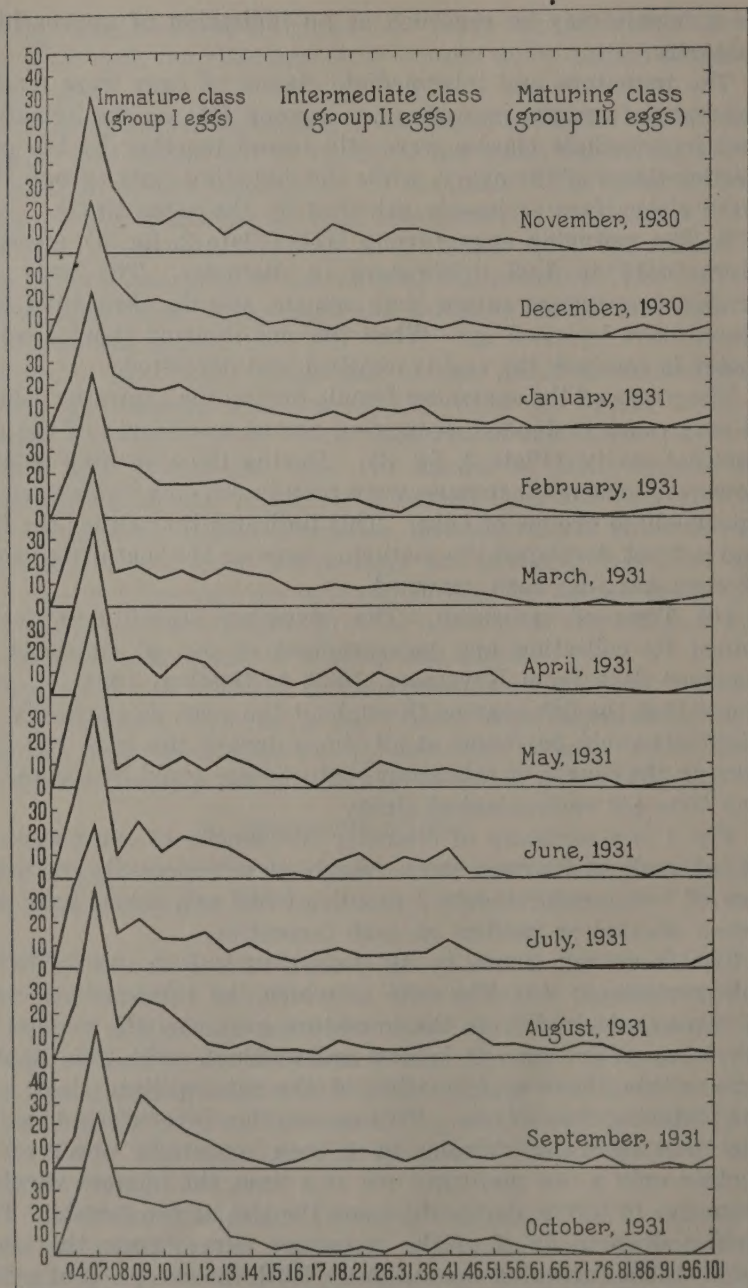


FIG. 1. Diameter frequencies of ova during the spawning season, Molawin Creek, November, 1930, to October, 1931. (Based on Table 1.)

the curve from the base of the mode, beginning with 0.09 millimeter and ending at 1.01 millimeters, represents a markedly gradual slope. Eggs about 1 millimeter in diameter are ready to be expelled.

(c) *Peak of spawning activity*.—Examination of mature females was made at intervals of fourteen days throughout the year. The percentage of spawning fish for each examination was computed. Table 5 shows that the greatest number of spawning fish was found in the samples collected during December, with a percentage of 58.67, and January, with 80.45 per cent. Greater spawning activity during January may be further indicated by the presence of larvæ of *Gulaphallus* in the stomachs of its own kind during that month. One year's examination of the stomach contents of both the immature and mature *Gulaphallus* shows that only during the month of January larvæ of this fish represented food of the same fish.

As may be expected, the least number of spawning *Gulaphallus* was found during May and June (Table 5). These conclusions, however, must be considered as tentative in view of the fact that sampling was done only twice a month. Our results to date, nevertheless, seem to show that the spawning season of *G. mirabilis* continues throughout the entire year.

FOOD AND FEEDING HABITS OF GULAPHALLUS

Thirty mature and thirty immature fish were collected, dissected, and examined every month. Tables 2 and 3 and figs. 2 and 3 show the results of the examination of the food of the fish. It may be seen that both the immature and the mature fish subsist upon practically similar kinds of food, the difference being merely in quantity.

(a) *Vegetable matter*.—Vegetable matter was found in the stomachs of both to the amount of 8.69 ± 0.978 per cent of the total bulk of food consumed by the mature and 13.01 ± 0.782 per cent by the immature. The difference of 4.319 ± 1.121 between the amount of vegetable matter consumed by the mature and by the immature fish is significant in indicating that as the fish become older they subsist very largely on animal matter. This food was found to be taken by both throughout the year, that is, from September, 1930, to August, 1931.

(b) *Chironomid larvæ and pupæ*.—These items rank first in importance among the food of the fish. They form $33.39 \pm$

2.38 per cent for the immature and 38.35 ± 2.02 per cent for the mature fish of the total bulk of food consumed. This animal food, like the vegetable matter, is taken by the fish as part of its diet throughout the year. The difference of 4.96 ± 3.12

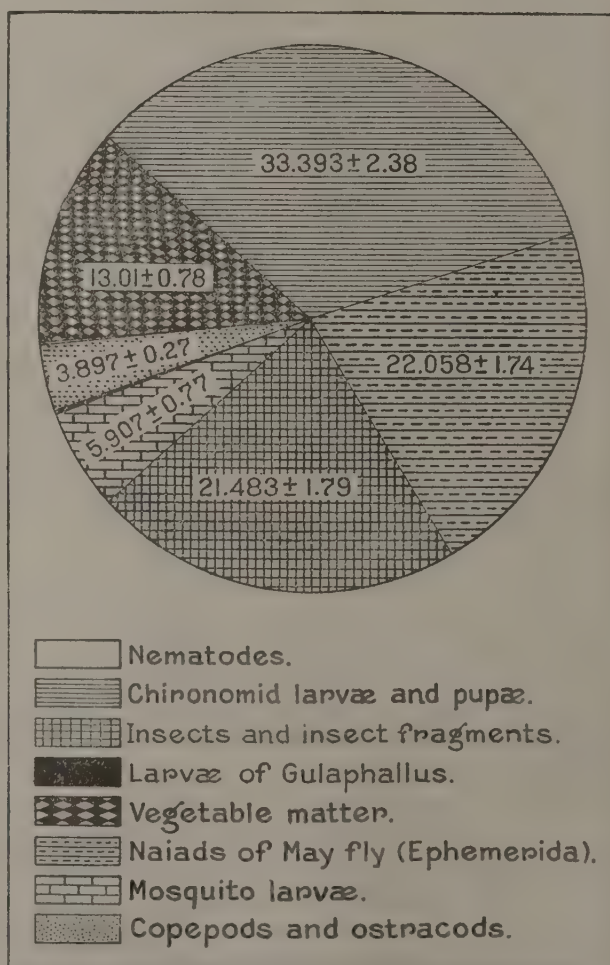


FIG. 2. Yearly proportions of food items consumed by the immature *Gulaphallus*.

per cent in the amount of these items consumed by the immature and mature groups is not significant.

(c) *Insects and insect fragments*.—Among the insects that were found occasionally in the stomachs of the mature fish were water beetles and adult mosquitoes. On the other hand, water

beetles, termites, and ants were found in the stomachs of the immature group. In each group, insects and insect fragments were represented in the diet throughout the year.

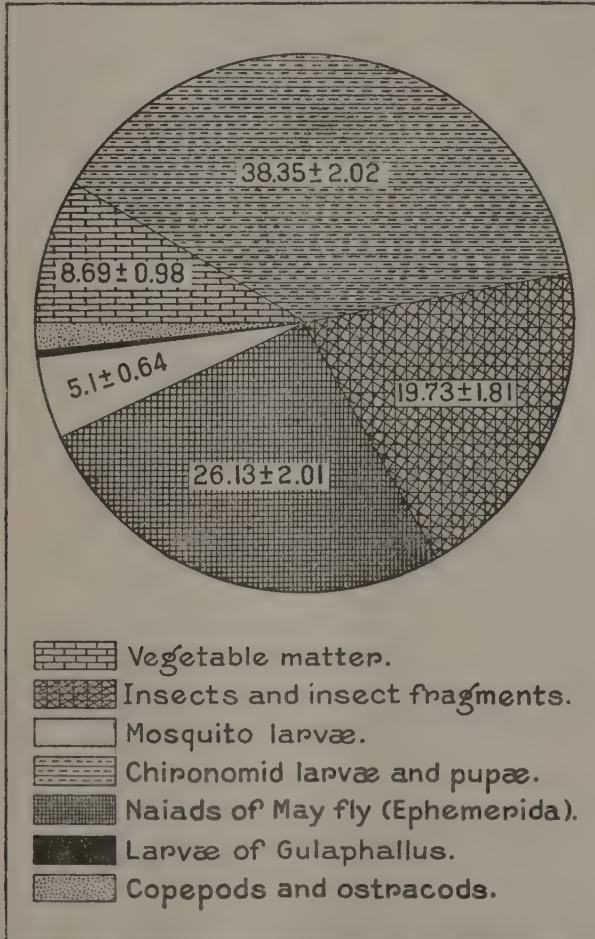


FIG. 3. Yearly proportions of food items consumed by the mature *Gulaphallus*.

Of the total bulk of food taken, the mature group consumed 19.73 ± 1.81 per cent and the immature, 21.48 ± 1.79 per cent. The difference of 1.75 ± 2.1 per cent, however, in the amount consumed by the two groups of fish was found to be of no significance.

(d) *Naiads of May flies (Ephemera)*.—The mature group consumed 26.13 ± 2.01 per cent and the immature 22.06 ± 1.74 per cent of the total bulk of food taken. Like the three foregoing items, naiads of May flies were represented in the stomachs of both groups of fish throughout the year. The difference of 4.074 ± 2.6 in the amount of these items consumed by the mature and immature groups is not significant.

(e) *Mosquito larvæ*.—These items were represented in the stomachs of both the mature and immature fish to the amount of 5.10 ± 0.641 per cent of the total bulk of food consumed for the mature and 5.91 ± 0.172 per cent for the immature. The difference of 0.81 ± 0.67 is not significant.

(f) *Larvæ of Gulaphallus*.—Outside the month of January, the larvæ of the fish were never represented in the monthly range of food of each group of fish. This food item formed 3.5 per cent of the total amount of food consumed for that month for the mature group and 2.05 per cent for the immature.

The larvæ of the fish as a part of its diet represent only 0.292 ± 0.62 per cent of the total bulk of food consumed for the mature and 0.171 ± 0.113 per cent for the immature. The difference of 0.121 ± 0.61 per cent in the total bulk of this item is not significant.

(g) *Copepods and ostracods*.—These crustaceans formed the least of the minor food of the fish. They formed only 3.90 ± 0.270 per cent of the total bulk of food consumed for the immature and 1.74 ± 0.285 for the mature. These items were also found in the stomachs of both groups of fish throughout the year. The difference of 2.192 ± 0.0391 per cent was found to be significant.

(h) *Nematodes*.—These formed only 0.083 ± 0.053 per cent of the total bulk of food consumed by the immature group. This item was found to be taken only in the month of November when it formed 1.00 per cent of the amount of food consumed for that month. It was not found in the stomachs of the mature fish. There is a possibility that these animals were parasitic in the alimentary tract of the young fish.

From the foregoing results of the feeding habits of *Gulaphallus* the following conclusions may be deduced:

1. It is apparent that both groups of fish are more insectivorous than herbivorous.

2. Chironomid larvæ and pupæ, naiads of May flies (*Ephemera*), and insects and insect fragments, form the major

portions of the animal food of both the mature and immature groups.

3. Mosquito larvæ, vegetable food materials, and crustaceans (copepods and ostracods) form minor foods of both.

4. Larvæ of *Gulaphallus* were taken by both groups of fish only during January. This apparently shows that the fish became accidental cannibals only during this month, when the peak of spawning activity was found to occur.

5. The essential difference between the food of the immature and mature fish is only in the amount of vegetable materials and crustacean food (copepods and ostracods) eaten. It is evident that the immature group took more vegetable food materials and crustacean food than the mature group. The immature fish appears to become insectivorous as it grows older. No indication, however, could be found that the mature fish at any stage prefers a particular kind of insect food.

EMBRYOLOGY OF *GULAPHALLUS MIRABILIS*

(a) *The newly laid eggs (Plate 2, fig. 4).*—These are highly transparent, spherical, with a diameter of about 1 millimeter. They are demersal eggs held by a tangle of adhesive threadlike processes (Plate 2, fig. 4, *at*), which arise from the different parts of the egg membrane. These adhesive processes attach the egg to any object in the spawning ground. It seems, however, that plants are preferred to stones and decaying wood as sites for oviposition.

The yolk sphere contains 70 to 80 oil globules of unequal size. Numerous tiny globules are also scattered through the cytoplasmic mass. Newly laid eggs that are presumably fertilized remain highly transparent up to one hour or more after laying.

(b) *Incubation period.*—Under laboratory conditions the period of incubation during the months covered by the experiment lasts from eight to eleven days with an average of 9.50 ± 0.079 days (Table 4). The eggs were hatched in Petri dishes containing tap water which was changed daily up to the time of hatching.

(c) *Embryology (Plate 2, figs. 4 to 22).*—Observations on the embryonic development were made exclusively on living materials. Newly laid eggs placed in Petri dishes half filled with tap water were used in this study.

TABLE 4.—*The incubation period of eggs of Gulaphallus under laboratory conditions (submerged in water).*

Lot No.	Eggs laid.	Eggs hatched.	Incubation period.
	1930	1930	Days.
I	11-XI	22-XI	11
II	17-XI	27-XI	10
III	22-XI	30-XI	8
IV	28-XI	8-XII	10
V	6-XII	15-XII	9
	1931	1931	
VI	26-I	4-II	9
VII	31-I	11-II	11
VIII	6-II	15-II	9
IX	6-II	16-II	10
X	8-II	16-II	8
Maximum			11
Minimum			8
Average			9.50±0.079

(d) *Early cleavage to formation of blastodisc.*—The newly laid eggs have a relatively narrow perivitelline space. This space apparently becomes wider about one hour or more after laying. The blastodisc (Plate 2, fig. 5, *bd*) becomes well differentiated about one hour after laying, appearing as a lenticular protrusion of protoplasm at one pole of the yolk sphere. As differentiation of the blastodisc proceeds, the oil globules collect at one pole of the yolk sphere, usually opposite the blastodisc.

First cleavage occurs about two hours after laying. The blastodisc divides into two approximately equal daughter cells (Plate 2, fig. 6). About three hours after laying, the second plane of cleavage appears, cutting the first at right angles and dividing the blastodisc into four approximately equal daughter cells (Plate 2, fig. 7).

The blastodisc with eight cells possesses distinct bilateral symmetry (Plate 2, fig. 8). After this stage, however, cell division becomes irregular, the bilateral arrangement of the constituent cells disappears, and cells of variable size are produced. A blastodisc about six hours old (Plate 2, fig. 10) appears somewhat dome-shaped with the periblast and periblastic nuclei (Plate 2, fig. 10, *pb*) becoming apparent around its periphery. The per-

TABLE 5.—The monthly percentage of mature egg-bearing *Gulaphallus* from samples collected at 14-day intervals from Molawin Creek.

Date.	Fish examined.	Fish with mature eggs.		Average for the month.
1930			P. ct.	P. ct.
15-XI.....	50	16	32.00	33.31
29-XI.....	52	18	34.62	
13-XII.....	51	34	66.67	58.67
27-XII.....	56	28	50.00	
1931				
10-I.....	54	48	88.89	80.45
24-I.....	50	36	72.00	
7-II.....	55	20	36.36	40.73
21-II.....	51	23	45.10	
7-III.....	56	27	48.21	40.77
21-III.....	60	20	33.33	
4-IV.....	62	20	32.26	34.31
18-IV.....	66	24	36.36	
2-V.....	58	19	32.76	27.49
16-V.....	54	12	22.22	
30-V.....	40	8	20.00	29.31
13-VI.....	45	13	28.88	
27-VI.....	51	20	39.22	43.94
11-VII.....	55	30	54.54	
25-VII.....	48	16	33.33	31.11
8-VIII.....	45	14	31.11	
22-VIII.....				
5-IX.....	50	14	28.00	32.75
19-IX.....	56	21	37.50	
3-X.....	40	18	45.00	47.29
17-X.....	56	28	50.00	
31-X.....	64	30	46.88	

iblastic nuclei are doubtless derived from the peripheral cells of the blastoderm and the periblast is believed to have something to do with the assimilation of the yolk by the developing embryo.

The blastoderm continues to increase in diameter and ultimately spreads over the entire surface of the yolk. In embryos nine hours old, the blastoderm covers about one-half of the surface of the yolk (Plate 2, fig. 11).

(e) *Formation of the primitive streak and early embryonic stages.*—The cell layers at the edge of the blastoderm thicken about twenty hours after hatching. This thickened region is the germ ring (Plate 2, fig. 12, *gr*). The subgerminal cavity (Plate 2, fig. 12, *sg*) becomes evident also at this time by the thinning of the central area of the blastoderm.

Before the germ ring is fully differentiated, however, a thickening becomes apparent at the posterior or embryonic pole of the blastoderm (Plate 2, fig. 12, *es*). This is the embryonic shield, a broad tongue of cells which grows forward (Plate 2, fig. 12, *es*). The embryonic shield grows larger and becomes more definitely outlined. About eight hours after the formation of the germ ring there occurs a linear thickening along its anteroposterior axis. This linear thickening is the primitive streak (Plate 2, fig. 13, *ps*), with the prospective head of the animal at its tip.

On the lateral sides of this, the lens and optic vesicles become apparent about thirty-six hours after oviposition. At this time also, five to seven somites are in evidence (Plate 2, fig. 14, *sm*). The oil globules are now grouped together at about the caudal end of the embryo. About twelve hours later, the eyes become prominent and from 14 to 16 somites are fully developed, (Plate 2, fig. 15). The oil globules are now diffusely scattered in the yolk mass. The metameric segments increase in number with the age of the embryo.

(f) *Later embryonic stages*.—Sixty-two hours after laying pigmentation begins to develop. The black pigments first appear as rounded dots scattered over the dorsal and lateral aspects of the head. Early embryonic circulation also becomes manifest at this time. The heart (Plate 2, fig. 16, *h*) is very distinct. The membranous fold which extends from the mid-dorsal region around the caudal end and along the ventral side of the embryo, is already differentiated (Plate 2, fig. 16, *mf*). The embryo now covers about two-thirds of the surface of the yolk sphere.

About twenty-six hours later, the punctiform black pigments develop into pigmented processes which are scattered from the dorso-medial aspect of the head up to the anterior portion of the trunk region (Plate 2, fig. 17).

The formative pectoral fins are observed in embryos about one hundred two hours after laying. They appear as more or less triangular protrusions arising laterally at about the neck region (Plate 2, fig. 18, *pa*). The black chromatophores increase in number and size on the dorsal aspect of the head, pectoral region, and extra-embryonic area.

The embryo has grown considerably in length and has completely extended around the circumference of the yolk sphere by about one hundred twenty-six hours after laying. The for-

mative pectoral fins are also considerably elongated. The black chromatophores have increased further in number on the dorsal aspect of the head, the anterior region of the trunk, and along the lateral and dorsal sides of the body (Plate 2, fig. 19). About thirty-four hours later, the formative pectoral fins become differentiated into pectoral fins (Plate 2, fig. 20). The black chromatophores become aggregated on the top of the head.

About three hours before hatching, the embryo has grown considerably in size (Plate 2, fig. 21). The head is very much enlarged and occupies almost one-third of the egg. The yolk is materially reduced, and the larva is observed wiggling furiously at about this time.

The larva is liberated about two hundred and eleven hours after laying. It is very active soon after its escape from the egg membrane. The black chromatophores are now arranged in series along the dorsal aspect of the head.

The exact cause of the rupture of the egg membrane could not be determined. It was assumed, however, that the rupture was due to the wiggling action of the larva.

POSTEMBRYONIC DEVELOPMENT, WITH SPECIAL REFERENCE TO THE DEVELOPMENT OF THE MALE COPULATORY ORGANS

In the study of the development and position of the male copulatory organs of *Gulaphallus*, newly hatched fish reared in glass aquaria were used. The work was carried on for three and one-half months, from June 15 to October 31, 1931. Observations were made at intervals of seven days on twenty newly hatched larvæ.

(a) *The newly hatched larva (Plate 2, fig. 22).*—Newly hatched larvæ measure about 4 millimeters in length. The head is somewhat enlarged and flattened ventrally and convex dorsally; the eyes are large and slightly elliptical; the body is transparent, slender, and slightly tapering posteriorly. Black chromatophores are visible from the dorsal aspect of the head and along the dorsal and lateral sides of the body up to the caudal region.

The yolk sac which appears as an orange semiovoid structure is located on the ventral side, a little posterior to the head region. Resorption of the yolk is complete about two or three days after hatching. The pectoral fins, aided by the vibratory movement of the caudal region, are used as the primary propellers of the body for swimming.

The mid-dorsal region gives rise to a low median fold which continues to form around the caudal end and subsequently extends its formation along the ventral side, ending at the posterior border of the yolk sac.

(b) *Early manifestation and development of the fins.*—About the first and the second week after hatching, the ventral, mid-dorsal, and anal folds begin to disintegrate. Yellowish orange chromatophores appear among the original black chromatophores on the dorsal aspect of the head and along the lateral sides of the body.

Delicate fin rays become manifest on the caudal, mid-dorsal, and ventral folds about three to four weeks after the animal hatches (Plate 3, fig. 1). It is apparent that the second dorsal, anal, and caudal fins in *Gulaphallus mirabilis* develop synchronously. About five weeks after hatching, the second dorsal, anal, and caudal undergo rapid development, while the first dorsal fin is not yet in evidence (Plate 3, fig. 2).

(c) *Early differentiation and development of the male copulatory organs.*—In twelve of the twenty larvæ indications of the formative copulatory organs of the male are first seen at about the sixth or the seventh week after hatching. They appear as bilobed, posteriorly directed outgrowths originating from the ventral side of the throat region and extending to about the base of the pectoral fins (Plate 3, figs. 5 and 5a, cpa). The anal opening, *a*, is discernible between the bases of these two outgrowths. At about this time, the first dorsal fin also makes its appearance a few millimeters anterior to the second dorsal fin. The first dorsal fin at this stage possesses two spinous rays, which is characteristic of the genus.

During the eighth and the ninth week, the formative copulatory structures increase in size. By about the tenth week, one of the lobes outgrows the other and the two coalesce along the ental side (Plate 3, figs. 6 and 6a). About the twelfth and the thirteenth week (Plate 4, figs. 1 and 1a) the fused lobes develop into a more or less elongate subfusiform structure. At this stage this structure is intimately apposed along almost its entire length from the base subdistally to the throat of the fish. This stage marks the beginning of the development of the priapium.

(d) *Early development of the priapium and manifestation of the priapial accessory appendages.*—Fourteen weeks after the fish hatches, the priapium elongates. The anterior end of the priapium is in line with the centers of the eyes and the posterior

end extended to about half beyond the pectoral fins (Plate 4, figs. 2 and 2a). The anus now begins to assume a lateral left or right position, on account of the twisting of the priapium. A cartilaginous protuberance, which is apparently the formative toxactinium, arises on the aproctal side lateral to the posterior part of the priapium (Plate 4, fig. 2a, *tf*). This formative structure cannot possibly be the formative penislike structure, because as seen in the subsequent stages, the latter is postero-mesal in position.

About the fifteenth or the sixteenth week after the animal hatches, the formative penislike structure and the formative ctenactinium are already in evidence (Plate 4, figs. 3 and 3a). The formative penislike structure appears as a fleshy protuberance at the posterior end of the priapium. Because of the twisted condition of the priapium this structure seems to be inclined towards one side, adjoining the developing toxactinium. The formative ctenactinium appears as a slender cartilaginous thickening along the ventral side of the priapium. The priapium at this time increases considerably in length towards the anterior end to about the base of the lower jaw.

It appears that the priapial appendages are homologous lateral structures, one becoming the toxactinium and the other the ctenactinium, depending upon which side the priapium twists to. The toxactinium then is the one that ultimately retains a lateral position and the ctenactinium, the ventral. These two structures fuse together at their bases during the early stages of development, and probably develop from a common base.

(e) *Later development of the priapium and its accessory appendages.*—About seventeen weeks after the animal hatches, the distal part of the short ctenactinium (Plate 4, figs. 4 and 4a) is free. The toxactinium increases considerably in length until the tip is about in line with the centers of the eyes. The toxactinium and the ctenactinium at this stage of development are cartilaginous. At about the eighteenth week, four of the ten males in the culture have fully developed priapia and upon dissection are found to be sexually mature. At this stage also, the ctenactinium is completely free from the priapial muscle in its entire extent. The priapium when fully developed extends from the base of the lower jaw to the anterior limit of the throat. The posterior or basal end of the priapium is very much enlarged due to the complete development of the seminal vesicle (Plate 4, figs. 4 and 4a, *sv*).

The fully developed ctenactinium (Plate 4, figs. 5 and 5a) is broad and shorter than the toxactinium, and has an expanded tip, which is concave and emarginate distally. At this stage the toxactinium has increased further in length up to about the base of the lower jaw. The penislike structure, likewise, has apparently attained its maximum development; it is pointed antero-laterally, with the opening of the vas deferens at its somewhat forked tip. Its distal end is placed between the proximal portions of the toxactinium and the ctenactinium. It develops also an axial bone at this stage of development. In the remaining six males the priapia and accessory appendages become fully developed about nineteen to twenty weeks after hatching. The full development of the priapium is an index of sexual maturity. Regan (1916) arrived at an identical conclusion in connection with this study on *Myxopterygia* and *Neostethus bicornis*, close relatives of *Gulaphallus*.

The fully developed toxactinium and ctenactinium (Plate 5, figs. 1 and 1a) is pliable, but bony instead of being cartilaginous. A part of the subdistal curve of the long ctenactinium rests in a groove formed by the lower jaw and the anterior portion of the priapium.

SUMMARY

1. Four members of the family Phallostethidæ are known in the Philippines, all from Luzon. These are *Mirophallus bikolanus* Herre, *Gulaphallus eximius* Herre, *Gulaphallus mirabilis* Herre, and *Gulaphallus amaricola* sp. nov.

2. A rather comprehensive treatise of the biology of *Gulaphallus mirabilis* Herre is presented in the present report.

3. Copulation in *G. mirabilis* is intromittent, the duration being one to two minutes.

4. In the aquarium the eggs of *Gulaphallus* are laid singly and attached to leaves and stems of *Ceratophyllum* by adhesive threadlike processes. The eggs receive no parental care after oviposition.

5. The fish spawns throughout the year, but spawning is at its height in December and January and rarest in May and June.

6. Three classes of ova are recognized as occurring simultaneously in the ovary of a spawning female; namely, the immature class (group I eggs), the intermediate class (group II eggs), and the maturing class (group III eggs).

7. The transformation of the immature group into the intermediate class of ova is gradual. The same is also true in the transformation of the intermediate class into the maturing class of ova.

8. The following salient points were observed in the embryology of *G. mirabilis*.

(a) The blastodisc became differentiated about one hour after laying, and the first act of cleavage occurs about one hour later. Cleavage is bilateral and regular up to the 8-cell stage, becoming irregular from the 16-cell stage.

(b) The periblast and periblastic nuclei become apparent about six hours after laying.

(c) The germ ring becomes evident about twenty hours after laying. The subgerminal cavity and the embryonic shield are also apparent by this time.

(d) The primitive streak appears about eight hours after oviposition.

(e) The embryonic circulation and pigmentation becomes apparent in embryos about sixty-two hours after laying.

(f) The primordial pectoral fins appear in embryos about one hundred two hours after laying, and by about fifty-eight hours later they differentiate into definitive pectoral fins.

9. The period of incubation of the eggs during the months covered by the experiment under laboratory conditions varies from eight to eleven days with an average of 9.50 ± 0.079 days.

10. The following is a summary of the post-embryonic development of the fish.

(a) The second dorsal, anal, and caudal fins appear synchronously about the third and fourth week after hatching.

(b) The primordial copulatory organs of the male first appear at about the sixth or the seventh week after hatching. At about this time the first dorsal fin makes its appearance.

(c) The early development of the priapium begins at about the twelfth and thirteenth week after hatching.

(d) The anlage of the toxactinium becomes evident about fourteen weeks after hatching.

(e) The anlagen of the penislike structure and of the ctenactinium make their appearance at about the fifteenth or the sixteenth week after hatching.

(f) The priapial appendages appear to be externally homologous lateral structures, one becoming the toxactinium and the other the ctenactinium, depending on whether the priapium takes a dextral or a sinistral turn.

(g) The toxactinium and the ctenactinium remain cartilaginous during the early stages of development. They become bony but pliable structures when fully developed at about the nineteenth or twentieth week.

(h) The priapium reaches its maximum development at sexual maturity, about the eighteenth week.

(i) The penislike structure attains its maximum development about eighteen weeks after hatching.

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ILLUSTRATIONS

PLATE 1

pv, pulvinulus; *et*, etenactinium; *p*, penislike structure; *co*, comblike projections;
a, anus; *o*, opening of oviduct; *pl*, papilla.

- FIG. 1. *Gulaphallus amaricola* sp. nov., male; 1*a*, ventral aspect of head region of male. (Drawn by E. Borbe.)
2. *Gulaphallus amaricola* sp. nov., female; 2*a*, ventral aspect of head region of female. (Drawn by E. Borbe.)

PLATE 2. EGGS OF GULAPHALLUS MIRABILIS HERRE

- FIG. 1. Immature egg, $\times 80$.
2. Intermediate egg, $\times 100$.
3. Maturing egg, $\times 52$.
4. Newly laid egg ($\times 40$) attached to a twig of *Ceratophyllum demersum* Linn. by adhesive threads, *at*.
5. One hour after oviposition; *bd*, blastodisc.
6. Two hours after oviposition.
7. Three hours after oviposition.
8. Four hours after oviposition.
9. Five hours after oviposition.
10. Six hours after oviposition; *pb*, periblast.
11. Nine hours after oviposition.
12. Twenty hours after oviposition; *gr*, germ ring; *sg*, subgerminal cavity; *es*, embryonic shield; *pp*, embryonic pole.
13. Twenty-eight hours after oviposition; *ps*, primitive streaks.
14. Thirty-six hours after oviposition; *sm*, somite.
15. Forty-eight hours after oviposition; 14 to 16 somites.
16. Sixty-two hours after oviposition; *h*, heart.
17. Eighty-eight hours after oviposition.
18. One hundred two hours after oviposition; *pa*, pectoral anlagen.
19. One hundred twenty-six hours after oviposition.
20. One hundred sixty hours after oviposition.
21. Two hundred hours after oviposition.
22. Newly hatched larva, $\times 40$; *ys*, yolk sac.

PLATE 3. GULAPHALLUS MIRABILIS HERRE

- FIG. 1. Three weeks after hatching, $\times 25$. (Drawn by P. R. Manacop.)
2. Five weeks after hatching, $\times 25$. (Drawn by P. R. Manacop.)
3. *Gulaphallus mirabilis* Herre, female, internal organs in situ, $\times 10$. (Drawn by P. R. Manacop.)
4. *Gulaphallus mirabilis* Herre, male, internal organs in situ, $\times 8$. (Drawn by P. R. Manacop.)
t, Testis; *ov*, ovary; *sv*, seminal vesicle; *p*, penislike structure; *a*, anus; *i*, coiled intestine; *s*, stomach; *ab*, air bladder; *u*, ureter; *o*, oviduct opening.

FIG. 5. Six to seven weeks after hatching, $\times 10$; *a*, anus; *cpa*, formative copulatory organ; *5a*, ventral aspect of same. (Drawn by P. Medel.)

6. Ten weeks after hatching, $\times 10$; *6a*, ventral aspect of same. (Drawn by P. Medel.)

PLATE 4. (DRAWN BY P. MEDEL)

FIG. 1. Twelve to thirteen weeks after hatching, $\times 10$; *a*, anus; *1a*, ventral aspect of same.

2. Fourteen weeks after hatching, $\times 10$; *tf*, formative toxactinium; *a*, anus; *2a*, ventral aspect of same.

3. Fifteen to sixteen weeks after hatching, $\times 10$; *3a*, ventral aspect of same; *ps*, formative penislike structure; *t*, toxactinium; *c*, formative ctenactinium.

4. Seventeen weeks after hatching, $\times 10$; *4a*, ventral aspect of same; *sv*, seminal vesicle.

5. Eighteen weeks after hatching; *5a*, ventral aspect of same.

PLATE 5. (DRAWN BY P. MEDEL)

FIG. 1. Nineteen to twenty weeks after hatching, $\times 10$; *1a*, ventral aspect of same to show fully developed priapial appendages; *c*, ctenactinium; *t*, toxactinium; *ps*, penislike structure.

2. *Gulaphallus mirabilis* Herre, in copulation, $\times 6$.

TEXT FIGURES

FIG. 1. Diameter frequencies of ova during the spawning season, Molawin Creek, November, 1930, to October, 1931. (Based on Table 1.)

2. Yearly proportions of food items consumed by the immature *Gulaphallus*.

3. Yearly proportions of food items consumed by the mature *Gulaphallus*.

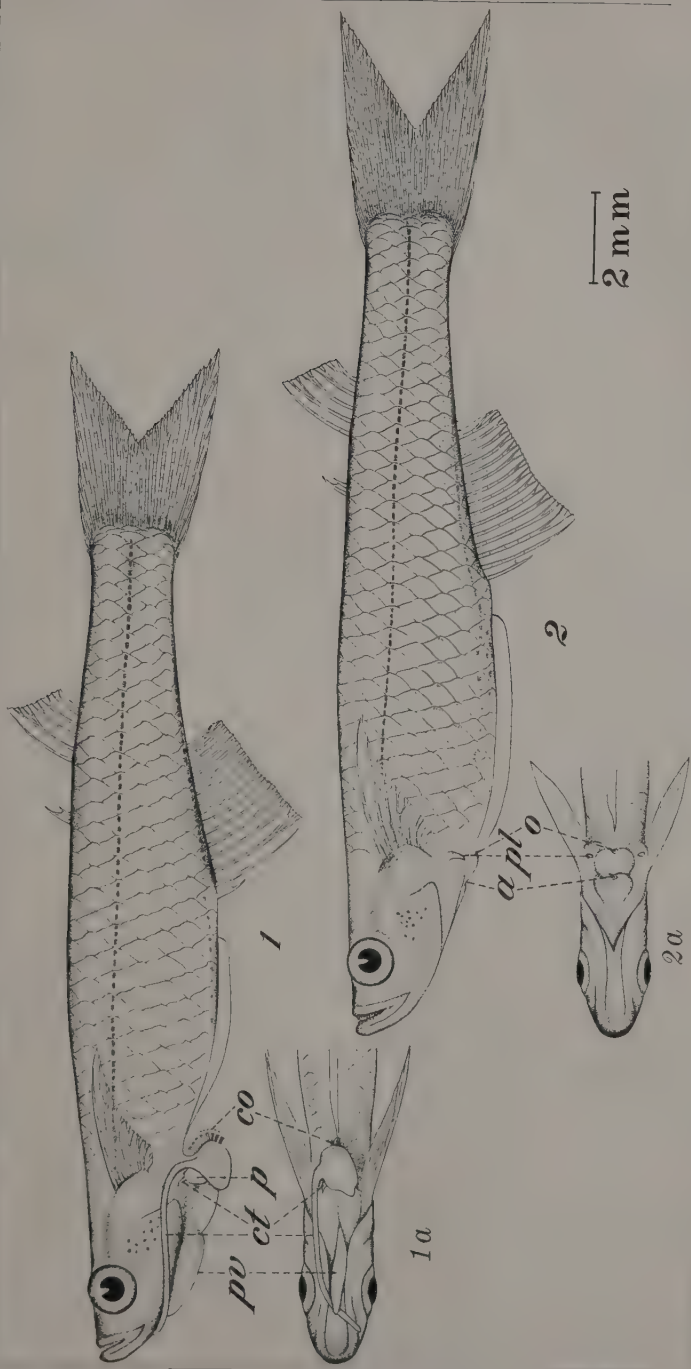


PLATE 1.



PLATE 2.

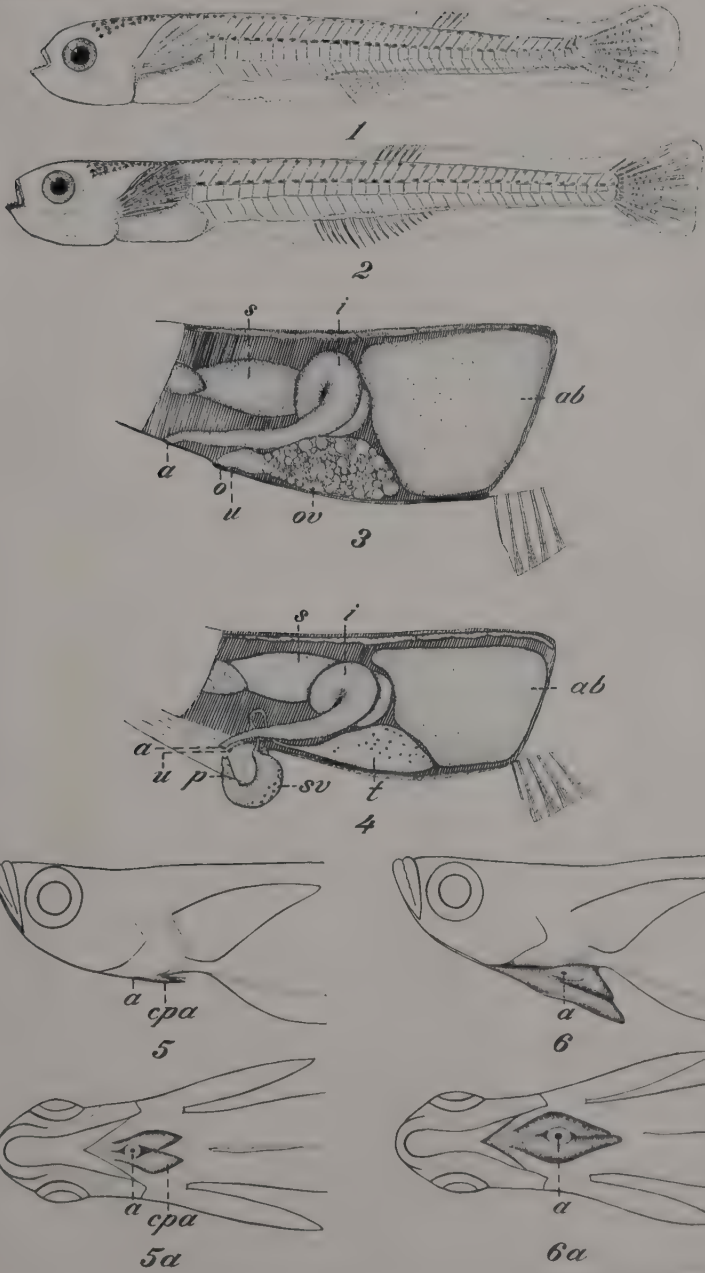


PLATE 3.

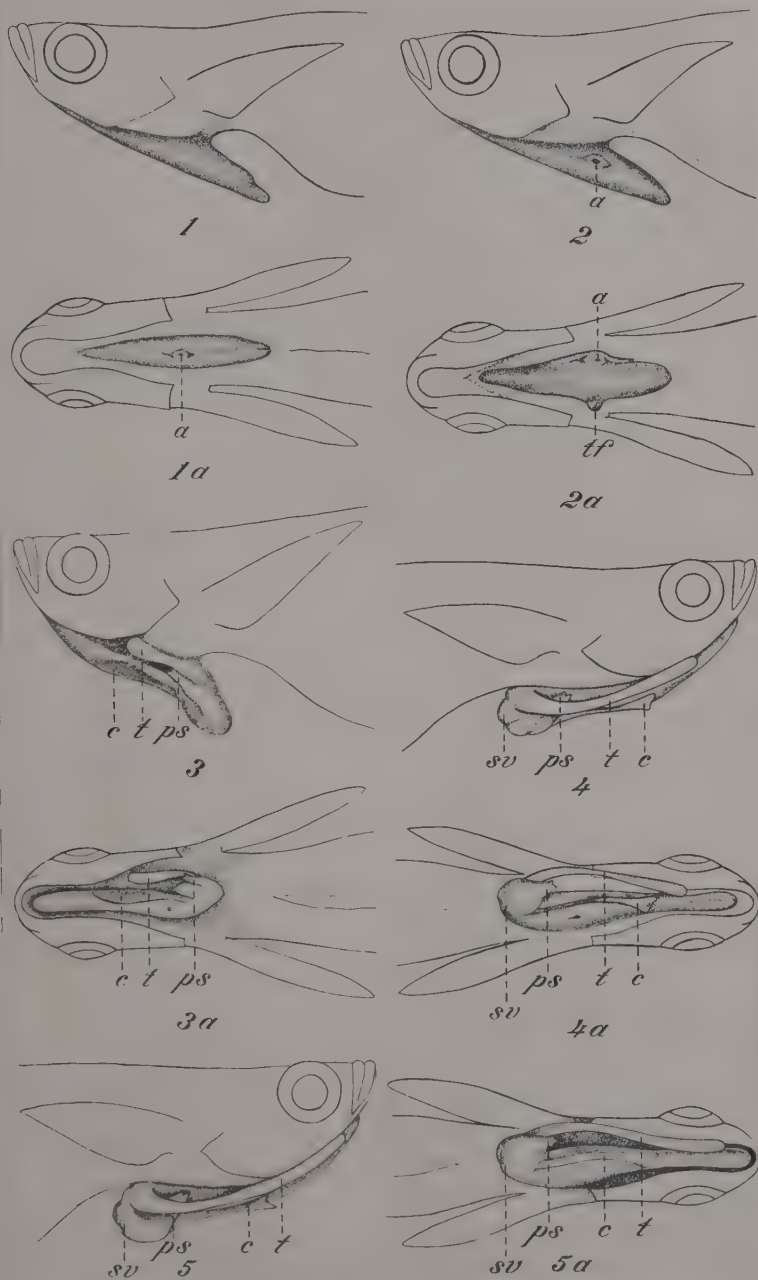


PLATE 4.

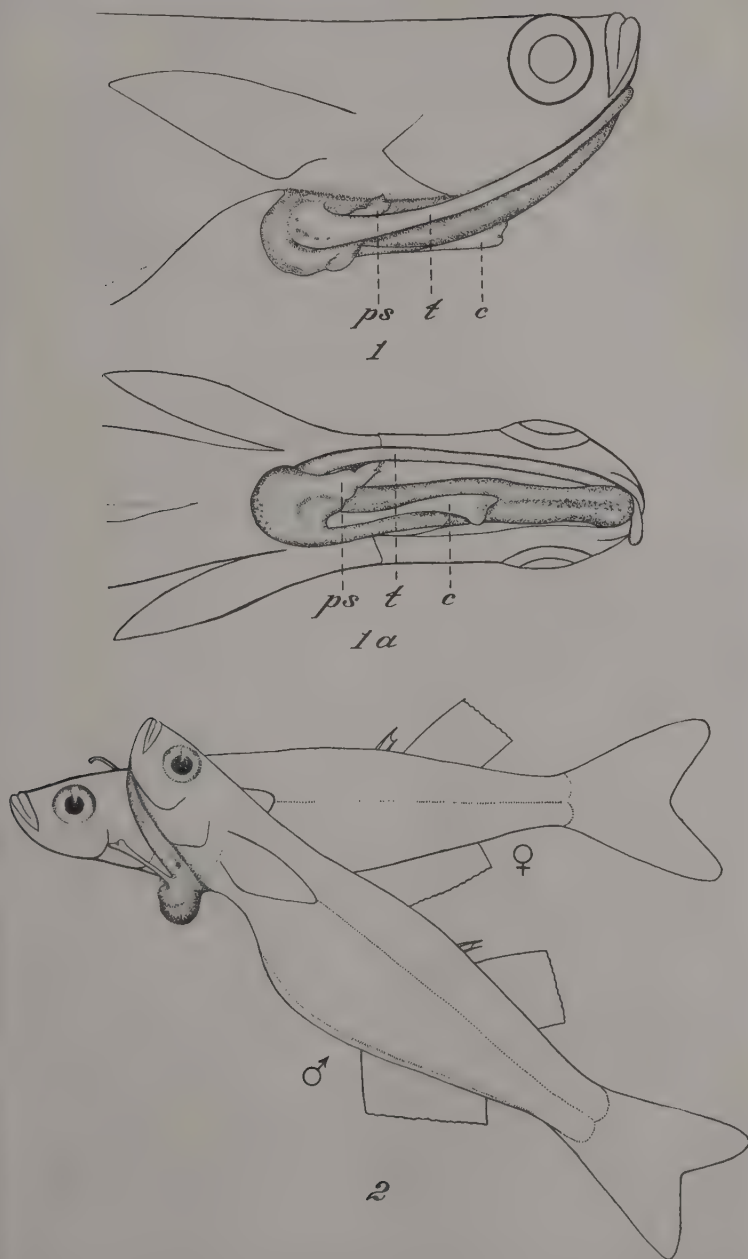


PLATE 5.

PHILIPPINE SILLAGINIDÆ

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ONE PLATE

In the present paper is given a review of Philippine fishes belonging to the family Sillaginidæ, based on material in the collection of the Fish and Game Administration. Three species are herein described, one of which is believed to be new to science.

SILLAGINIDÆ

Body elongate, little compressed, tapering both ways from the spinous dorsal; head conical, with its muciferous system fully developed as in the Sciaenidæ; eyes lateral, nearly median; pre-orbital very large, concealing the ends of maxillaries; mouth small, terminal, and slightly oblique, the upper jaw slightly the longer; villiform teeth in the jaws with the outer row rather conical, enlarged, and curved inward; teeth on vomer, none on palatines; preopercle serrated or crenulated; opercle armed behind with a short, flat spine; scales small, ctenoid, and cycloid; lateral line simple, slightly curved in front, and continued to base of caudal or a little beyond; two separate dorsal fins, the first short and consisting wholly of spines, the second very long, with one spine and over 17 rays; anal similar to second dorsal, with 2 spines; caudal emarginate; pectorals normal; ventral I, 5; branchiostegals 6; pseudobranchiæ present; air bladder simple; pyloric cæca few.

Fishes of this family are found from the Red Sea through the East Indies to Samoa, ranging northward to China, Korea, and Japan, and southward through the Philippines to the southeast of Australia. They are closely related to the Sciaenidæ and are known to ascend rivers and estuaries. Their flesh is esteemed as light and wholesome food.

Genus *SILLAGO* Cuvier

Sillago CUVIER, *Regne Animal*, 1st ed. 2 (1817) 258.

This genus includes most of the species of the family, including all those with villiform teeth, in which the soft dorsal and anal are similar to each other, scales small, and the ventral spine normal.

Key to the Philippine species of *Sillago*.

- α^1 . Dorsal fins XI-I, 20 to 22; anal II, 21 to 23; silvery longitudinal band on side of body indistinct or absent; scales on cheek in two rows, cycloid *S. sihama* (Forskål).
- α^2 . Dorsal fins XI-I, 17 to 19; anal II, 17 or 18; silvery longitudinal band on each side of body well pronounced; scales on cheek in three or four rows, cycloid or ctenoid.
- b^1 . With irregular blackish blotches on sides; longitudinal band narrow; scales on cheek ctenoid, in four rows.
S. maculata Quoy and Gaimard.
- b^2 . Without irregular blackish blotches on sides; longitudinal band wide; scales on cheek in three rows, those in upper row cycloid and in lower two rows ctenoid..... *S. argentifasciata* sp. nov.

SILLAGO SIHAMA (Forskål). Plate 1, fig. 1.

Atherina sihama FORSKÅL, Descr. Anim. (1775) 70.

Platycephalus sihamus BLOCH and SCHNEIDER, Syst. Ichth. (1801) 60.

Sciaena malabarica BLOCH and SCHNEIDER, Syst. Ichth. (1801) 81; CANTOR, Cat. Malay. Fish. (1850) 1003.

Sillago acuta CUVIER and VALENCIENNES, Hist. Nat. Poiss. 3 (1829) 296; BLEEKER, Percoidea, Verh. Batav. Gen. 22 (1849) 61; Kner, Reise, Novara (1865-1887) 128.

Sillago erythræa CUVIER and VALENCIENNES, Hist. Nat. Poiss. 3 (1829) 301.

Sillago sihama RÜPPELL, Reise, Nord. Afrika, Atlas (1826-31) 9, pl. 3, fig. 1; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 243; KLUNZINGER, Abh. Zool. Bot. Ges. Wien 20 (1870) 818; Sitzber. Akad. Wien (1880) 369; Fische Rothen Meeres (1884) 123; BLEEKER, Verh. Akad. Ams. 14 [(1873) 1874] 67; Atlas, Ichth. 9 (1877) pl. 389, fig. 4; DAY, Fish. India (1878-1888) 265; STEINDACHNER and DÖDERLEIN, Denkschr. Akad. Wien 49 (1884) 192; JORDAN and SNYDER, Proc. U. S. Nat. Mus. 24 (1902) 486; GILCHRIST and THOMPSON, Ann. South Afric. Mus. 6 pt. 2 (1908) 192; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 68; CHAUDHURI, Mem. Indian Mus. 5 (1923) 721; BARNARD, Ann. South Afric. Mus. 21 (1925-27) 507; FOWLER, Mem. Bishop Mus. 10 (1928) 235; WEBER and DE BEAUFORT, Fishes Indo-Austr. Arch. 6 (1931) 172, fig. 33; FOWLER, Bull. No. 100, U. S. Nat. Mus. 12 (1933) 417.

Dorsal XI-I, 20 to 22; anal II, 21 to 23; scales on lateral line to base of caudal 68 to 70; between lateral line and origin of dorsal 5; between lateral line and origin of anal 11.

Body slender and slightly compressed, its depth 5.2 to 6.1 in length; dorsal profile not much elevated, with the anterior portion rising evenly and gently from snout to dorsal fin; ventral outline nearly straight; head elongate, 3.2 to 3.9 in length of body; caudal peduncle narrow and short, its least depth 3.2 to 4.2 in head; interorbital space slightly convex, 4.9 to 6 in head;

eye large and ellipsoidal, located midway between tip of snout and posterior edge of preopercle, its maximum diameter 3.2 to 4.3 in the head; snout long and pointed, nearly twice as long as the maxillary, which is 4.1 to 5 in head; greatest width of preorbital very slightly exceeding the diameter of eye, 2.9 to 3.5 in head; mouth small, somewhat oblique, with the upper jaw a trifle the longer; teeth villiform in both jaws, those in the outer row slightly enlarged and directed inward; a broad patch of vomerine teeth present.

Body, nape, and opercle covered with finely ctenoid scales; those on preopercle and throat cycloid, on frontal cycloid and ctenoid; cheeks with two rows of cycloid scales, sometimes with small ones between; proximal two-thirds of supraorbital with four to five rows of very small ctenoid scales and the rest of head naked; all fins scaly; dorsals separate, the first one higher than the second and inserted on a line passing a little behind base of ventrals; origin of second or rayed dorsal opposite that of anal, both fins about equal in length; pectoral 1.7 to 1.9 in head and almost as long as ventral, both fins pointed; caudal emarginate.

Ground color of fresh specimens greenish olive, washed with grayish above lateral line from nape to caudal peduncle and becoming light silvery white below; an indistinct silvery yellowish longitudinal band below lateral line on posterior two-thirds of body; top of head to tip of snout dusky; preorbital grayish above and yellowish below; lower jaw, posterior half of premaxillary, cheek, and upper half of opercle yellow; spinous dorsal dotted with blackish and tipped with black to the sixth or eighth spine; soft dorsal tipped with blackish, the minute dots on membrane forming a blackish vertical band in front of each ray; pectoral yellowish gray; ventral and anal yellowish; caudal yellowish, with a broad margin of blackish above, below, and behind.

Alcoholic specimens slightly yellowish to brownish, generally lighter to dull silvery white at belly and grayish above lateral line from occiput to caudal peduncle; in many specimens a faint trace of dull silvery white longitudinal band present on posterior half of side to middle portion of caudal peduncle, in some it is absent; spinous and soft dorsals finely dotted with grayish and with blackish narrow edge; caudal yellowish, with outward portions of rays grayish; other fins yellowish.

Fifty specimens were examined, varying from 58 to 290 millimeters in length. They were collected at the following localities:

LUZON, Cagayan Province, Abulog: Ilocos Norte Province, Bangui: Ilocos Sur Province, Vigan: Zambales Province, Iba, Subic: Pampanga Province, Macabebe: Bulacan Province, Paombong: Manila: Rizal Province, Pasay: Batangas Province, Nasugbu, Balayan Bay: Camarines Sur Province, Sibubu, San Miguel Bay: Albay Province, Legaspi. MINDORO, Mindoro Province, Pinamalayan. SAMAR, Samar Province, San Pedro Bay. LEYTE, Leyte Province, Dulag, Carigara. PANAY, Iloilo Province, Barotac Nuevo, La Paz, Molo, Zarraga. NEGROS, Negros Oriental Province, Tanjay. PALAWAN, Palawan Province, Guinlo, Puerto Princesa, Panacan. MINDANAO, Agusan Province, Agusan: Misamis Province, Cagayan: Davao Province, Davao.

This species is common in the Philippines and occurs from the Red Sea through seas of India to the Malay Archipelago, ranging northward to China, Japan, and Korea, and eastward to Samoa. It ascends tidal waters and reaches a length of more than one foot. It has been recorded by Günther from the Philippine Islands, by Jordan and Seale from Cavite and Negros Island, and by Jordan and Richardson from Aparri.

SILLAGO MACULATA Quoy and Gaimard. Plate 1, fig. 2.

Sillago maculata QUOY and GAIMARD, Voy. Uranie et Physicienne (1824) 261, pl. 53, fig. 2; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 3 (1829) 303; BLEEKER, Verh. Bat. Gen. 22 (1849) 62; Verh. Akad. Ams. 14 (1874) 71; Nat. Tijdschr. Ned. Indië 13 (1858-59) 161; Verh. Akad. Ams. 14 [(1873) 1874] 71; Atlas Ichth. 9 (1877) 389, fig. 5; GÜNTHER, Cat. Fish. Brit. Mus. 2 (1860) 245; KNER, Novara-Exp. Fische (1865-67) 127; DAY, Fishes of India (1878) 265; MACLEAY, Descr. Cat. Austr. Fish. 1 (1881) 201; McCULLOCH, Austr. Zool. 1 (1919) 51; BARNARD, Ann. S. African Mus. 21 (1925-28) 508; WEBER and DE BEAUFORT, Fishes Indo-Austr. Arch. 6 (1931) 174; FOWLER, U. S. Nat. Mus. Bull. No. 100 12 (1933) 423.

Sillago burrus RICHARDSON, Icon. Piscium (1843) 5.

Sillago gracilis ALLEYNE and MACLEAY, Proc. Linn. Soc. N. S. W. 1 (1877) 279, pl. 6, fig. 2.

Dorsal XI-I, 19; anal II, 17 or 18; scales on lateral line to base of caudal 69; between lateral line and origin of dorsal 6; between lateral line and origin of anal 13.

Body elongate and slightly compressed, with dorsal outline fairly well arched and ventral contour nearly straight; depth 4.5 to 5.2 in length; greatest depth of head nearly twice in its length which is 3.2 to 3.4 in that of body; caudal peduncle narrow and compressed, its least depth 3.4 to 3.9 in head; inter-orbital space slightly convex, 5 to 5.6 in head; eye large and ellipsoidal, located closer to posterior edge of opercle than to tip of snout, its maximum diameter 3.3 to 3.6 in head; snout rather pointed, 2.4 to 2.5 in head; maxillary a little shorter than eye, being 4 to 4.4 in head and reaching to nearly halfway below front edge of eye; greatest width of preorbital 2.9 to 3.2 in head; mouth small and slightly oblique, with the upper jaw a trifle the longer; teeth villiform in both jaws, the outer row a little enlarged and curved inward; a band of teeth on vomer; vertical limb of preopercle finely serrated; opercle with a small spine behind.

Scales on body, nape, and opercle ctenoid, those on cheek ctenoid, in four rows; scales on preopercle and throat cycloid, on frontal both cycloid and ctenoid; a patch of fine scales on supraorbital; scales also present on all fins; first dorsal higher than the second, its spines weak and decreasing in height from the second which is 1.9 to 2.6 in head, pectoral 1.6 to 2 in head; ventral a little shorter than pectoral; caudal forked.

Ground color in alcohol yellowish to brownish, slightly grayish along back, becoming dull white on abdomen; some irregular blackish blotches on sides; a dull silvery longitudinal band running from above base of pectoral to caudal peduncle; upper half of spinous dorsal blackish; outer edges of soft dorsal blackish, the rest of fin with two longitudinal bands of like color; caudal washed with grayish behind; other fins colorless.

The above description is taken from five specimens, 90.5 to 147.7 millimeters in length, collected from the following places:

LUZON, Manila. LEYTE, Leyte Province, Tacloban. PANAY, Iloilo Province, Estancia. PALAWAN, Palawan Province, Panacan.

This well-marked species ranges from the Andamans, through the Malay Archipelago, to the southeast of Australia. It is said to attain 8 or 9 inches in length.

This fish has been reported by Kner from Manila.

SILLAGO ARGENTIFASCIATA sp. nov. Plate 1, fig. 3.

Dorsal XI-I, 17 or 18; anal II, 17; scales on lateral line to base of caudal 66; between lateral line and origin of dorsal 5; between lateral line and origin of anal 9.

Body slender, a little compressed, its depth 4.9 to 5.3 in length; dorsal and ventral profiles evenly and almost equally arched, the deepest portion at origin of second dorsal and anal; head elongate, rather sharply pointed, 3.3 to 3.4 in length of body; caudal peduncle compressed, its least depth 11.6 to 12.1 in length of body, 3.4 to 3.6 in head; eye large and ellipsoidal, located slightly nearer posterior edge of opercle than tip of snout, its maximum diameter 3.4 to 3.5 in head; interorbital space flat, almost 2 in snout and 5.5 to 5.6 in head; snout pointed, 2.4 to 2.6 in head, its upper outline very slightly arched; maxillary 4.3 to 4.9 in head and 1.8 to 1.9 in snout, ending behind halfway between tip of snout and vertical through anterior edge of eye; greatest width of preorbital 2.9 to 3.4 in head; mouth small and slightly oblique; lower jaw a little included; vertical limb of preopercle serrated; teeth villiform in both jaws, those in outer row enlarged and bent forward; a band of teeth on vomer.

Body, nape, and opercle covered with finely ctenoid scales; cheek with three rows of scales, those on upper row cycloid and on lower two rows ctenoid; preopercle and throat with cycloid scales; frontal scales both cycloid and ctenoid; caudal scaly, rest of fins naked; a patch of small scales present on supra-orbital; dorsal spines decreasing in height to the last, the first one 2.2 to 2.4 in head; pectoral longer than ventral, 1.7 to 1.8 in head; caudal deeply forked.

Ground color in alcohol dull silvery white; a well-pronounced, brilliant, silvery, longitudinal band, widest between the anterior portions of anal and second dorsal, runs on side from above base of pectoral to base of caudal; anteriorly this band is below the lateral line and posteriorly its upper edge touches it; breast and opercle brilliant silvery; upper portion of each dorsal spine and ray sparsely dotted with blackish; all other fins hyaline.

This species is distinct in having three rows of scales on the cheek and a wide, brilliant, silvery, longitudinal band on each side of the body.

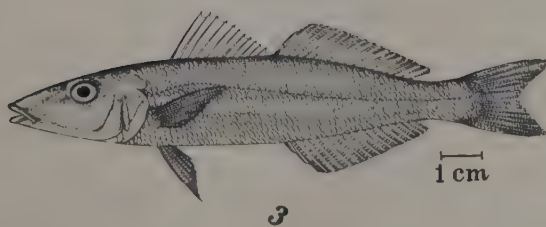
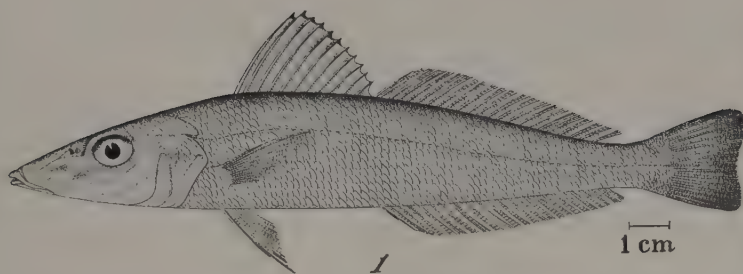
Here described from the type, No. 15680. Cotypes, Nos. 31146 and 31147, all deposited in the collection of the Fish and Game Administration; all obtained November 29, 1927, at Lumbucan Island, Palawan. The three specimens range in size from 81.8 to 116.3 millimeters.

Argentifasciata, silver-banded.

ILLUSTRATION

PLATE 1

- FIG. 1. *Sillago sihama* (Forskål); natural size. Drawn by Pablo Bravo.
2. *Sillago maculata* (Quoy and Gaimard); natural size. Drawn by Antonio Canlas.
3. *Sillago argentifasciata* sp. nov.; natural size. Drawn by Pablo Bravo.



A REVIEW OF PHILIPPINE ISOSPONDYLOUS FISHES

By HILARIO A. ROXAS

Of the Fish and Game Administration, Bureau of Science, Manila

THREE PLATES

Although the isospondylous fishes comprise some of the most important food fishes of the Philippines and are encountered in the market the year around, nothing extensive on their taxonomy has been written. In the collection of the Fish and Game Administration are numerous examples of fishes belonging to this order, which have been gathered from various parts of the Archipelago by various persons since 1907. An attempt is made here to present a systematic record of this material, so that the confusion arising from wrong identification and from nonuniformity of taxonomic treatment may be partially if not completely eliminated. Günther (1887), Smith and Seale (1906), Jordan and Seale (1907), Evermann and Seale (1907), Seale and Bean (1907), Jordan and Richardson (1908), Fowler (1918, 1931), and Herre (1927, 1934) mentioned some of the species of this order. This is the first time, however, that detailed descriptions and complete synonyms of all the Philippine representatives of the group are given in one paper.

This is the second paper dealing with the systematics of Philippine fishes that are of economic or commercial importance. As is mentioned in a previous paper (Roxas, 1934), these studies on taxonomy have to be made before the breeding habits, life histories, and feeding habits of these animals can be adequately studied.

The isospondylous fishes are bony fishes whose fins do not possess true spines, being provided mostly with soft fin rays. The ventral fins, if present, are always abdominal in position. The tail is homocercal, but the hæmal supports are fused or not much expanded. The opercle is well developed, and its bones are complete. The pectoral arches are suspended from the cranium. In the living (nonextinct) forms the air bladder is connected with the œsophagus in the adult. The spiral value of the intestine is either incomplete or wanting.

Previously reported examples of isospondylous fishes in the Philippines belong to twelve families, thirty genera, and fifty-one species, as shown in the following check list:

ELOPIDÆ

ELOPS HAWAIENSIS Regan.

Elops saurus Evermann and Seale (1906) Bulan; Jordan and Richardson (1907) Manila.

Elops hawaiiensis Fowler (1918) Philippines; Herre (1934) Manila, Capiz, and Dumaguete.

Elops hawaiiensis Fowler (1927) Orani.

MEGALOPS CYPRINOIDES (Broussonet).

Megalops cyprinoides Jordan and Seale (1905) Negros; Evermann and Seale (1906) Bulan; Weber and de Beaufort (1913) Philippines; Fowler (1918) Philippines; Fowler (1927) Vigan, Orion, Philippines; Herre (1934) Bauang Sur, Bulacan, Manila.

ALBULIDÆ

ALBULA VULPES (Linnaeus).

Albula vulpes Herre (1934) Jolo.

CHANIDÆ

CHANOS CHANOS (Forskål).

Chanos chanos Jordan and Seale (1906) Cavite; Jordan and Richardson (1907) Manila; Evermann and Seale (1907) Manila; Seale and Bean (1907) Zamboanga; Fowler (1918) Philippines; Fowler (1927) San Fernando, Vigan, Orani, Philippines; Herre (1934) Bulacan, Malabon, Cavite, Capiz, La Paz (Iloilo), Dumaguete.

CHIROCENTRIDÆ

CHIROCENTRUS DORAB (Forskål).

Chirocentrus dorab Jordan and Seale (1906) Cavite; Evermann and Seale (1906) San Fabian, Bacon; Jordan and Richardson (1907) Manila; Weber and de Beaufort (1913) Philippines; Fowler (1918) Philippines; Fowler (1922) Cebu; Fowler (1927) Vigan; Herre (1934) Unisan, Capiz, Cebu, Dumaguete, Jolo.

DUSSUMIERIIDÆ

SPRATTELLOIDES GRACILIS (Schlegel).

Stolephorus gracilis Evermann and Seale (1906) Bacon.

Spratelloides gracilis Weber and de Beaufort (1913) Philippines.

SPRATTELLOIDES DELICATULUS (Bennett).

Stolephorus delicatulus Evermann and Seale (1906) Bacon and Bulan; Fowler (1927) Bacon.

Spratelloides delicatulus Weber and de Beaufort (1913) Philippines; Herre (1934) Calapan, Culion, Dumaguete.

DUSSUMIERIA ACUTA Cuvier and Valenciennes.

Dussumieria acuta Kner (1865) Manila; Weber and de Beaufort (1913) Philippines; Fowler and Bean (1922) Cebu; Deraniyagala (1929) Philippines.

Dussumieria clopsoides Jordan and Seale (1906) Cavite; Jordan and Richardson (1907) Iloilo.

DUSSUMIERIA HASSELTII Bleeker.

Dussumieria hasseltii Jordan and Richardson (1907) Manila; Weber and de Beaufort (1913) Philippines; Fowler (1918) Philippines; Fowler (1927) San Fernando, Orani, Orion, Philippines; Herre (1934) Gulf of Lingayen, La Union Province, Unisan, La Paz, (Iloilo), Cebu.

ETRUMEUS ALBULINA Fowler.

Etrumeus albulina Fowler (1934) Iloilo.

DOROSOMIDÆ**NEMATALOSA NASUS** (Bloch).

Konosirus thrissa Evermann and Seale (1906) Philippines; Herre (1934) Sitanki.

Konosirus nasus Seale and Bean (1907) Zamboanga.

Dorosoma nasus Weber and de Beaufort (1913) Philippines.

Nematalosa nasus Herre (1934) Culion.

ANODONTOSTOMA CHACUNDA (Hamilton-Buchanan).

Anodontostoma chacunda Evermann and Seale (1906) Bacon; Jordan and Seale (1906) Cavite; Jordan and Richardson (1907) Manila and Iloilo; Fowler (1918) Philippines; Fowler (1927) San Fernando, Santa Maria, Orani, Orion, Philippines; Fowler (1931) Philippines; Herre (1934) Bauang Sur, Manila.

Dorosoma chacunda Weber and de Beaufort (1913) Philippines.

ENGRAULIDÆ**THRISINA BÆLAMA** (Forskål).

Anchovia baelama Jordan and Richardson (1907) Cagayancillo and Iloilo; Seale and Bean (1907) Zamboanga.

Engraulis baelama Weber and de Beaufort (1913) Philippines; Fowler (1927) Sta. Maria.

Thrissina baelama Herre (1934) Capiz, Cebu, Cotabato.

SCUTENGRAULIS HAMILTONII (Gray).

Engraulis hamiltonii (1907) Manila, Iloilo; Fowler (1927) Philippines.

Engraulis grayi Weber and de Beaufort (1913) Philippines.

THRISSOCLES SETIROSTRIS (Broussonet).

Anchovia setirostris Jordan and Richardson (1907) Aparri.

Engraulis setirostris Weber and de Beaufort (1913) Philippines; Fowler (1927) Philippines.

Thrissocles setirostris Fowler (1931) Philippines; Herre (1934) Bauang Sur, Capiz.

ENGRAULIS DUSSUMIERI Cuvier and Valenciennes.

Engraulis dussumieri Herre (1934) Dumaguete.

ENGRAULIS VALENCIENNESI (Bleeker).

Engraulis valenciennesi Fowler (1927) Orani.

STOLEPHORUS HETEROLOBUS Rüppell.

Stolephorus heterolobus Herre (1934) Dumaguete.

STOLEPHORUS COMMERSIONII Lacépède.

Anchovia commersoniana Jordan and Seale (1906) Cavite.

Anchovia commersonii Fowler (1918) Philippines; Fowler (1927) San Fernando, Bangued, Sta. Maria, Vigan, Philippines.

Scutengraulis commersonii Fowler (1931) Philippines.

Stolephorus commersoni Herre (1934) Bauang Sur, Dumaguete.

STOLEPHORUS INDICUS (van Hasselt).

Anchovia indica Jordan and Seale (1906) Cavite; Evermann and Seale (1906) Bulan.

Engraulis indicus Fowler (1927) Orion, Philippines.

Stolephorus indicus Weber and de Beaufort (1913) Philippines; Herre (1934) Cebu, Dumaguete, Atimonan.

Scutengraulis indica Fowler (1931) Philippines.

STOLEPHORUS TRI (Bleeker).

Stolephorus tri Weber and de Beaufort (1913) Philippines; Herre (1934) Bauang Sur, Manila, Cotabato.

Engraulis tri Fowler (1927) Sta. Maria, Orion, Orani, Philippines.

Scutengraulis tri Fowler (1931) Philippines.

CLUPEIDÆ**CLUPEOIDES LILE** (Cuvier and Valenciennes).

Clupeoides lile Herre (1934) Unisan, Dumaguete.

SARDINELLA LEIOGASTER Cuvier and Valenciennes.

Sardinella leiogaster Herre (1934) Jolo.

SARDINELLA CLUPEOIDES (Bleeker).

Sardinella clupeoides Evermann and Seale (1906) Bulan; Herre (1934) Cullion.

Clupea (Amblygaster) clupeoides Weber and de Beaufort (1913) Philippines.

SARDINELLA SIRM (Rüppell).

Clupea (Amblygaster) sirm Weber and de Beaufort (1913) Philippines.

Sardinella sirm Fowler (1931) Philippines; Herre (1934) Dumaguete.

SARDINELLA BRACHYSOMA (Bleeker).

Sardinella brachysoma Fowler (1927) Sta. Maria, Orani, Orion; Fowler (1931) Philippines.

SARDINELLA MELANURA (Cuvier and Valenciennes).

Harengula vanicoris Jordan and Seale (1906) Philippines.

Clupea melanura Seale and Bean (1907) Zamboanga.

Clupea (Harengula) melanura Weber and de Beaufort (1913) Philippines.

Sardinella melanura Fowler (1927) Vigan, Sta. Maria; Herre (1934) Cape Bolinao, Pangasinan.

SARDINELLA PERFORATA (Cantor).

Sardinella perforata Evermann and Seale (1906) Bacon; Fowler (1931) Philippines; Herre (1934) Manila.

Clupea (Harengula) perforata Weber and de Beaufort (1913) Philippines.

SARDINELLA FIMBRIATA (Cuvier and Valenciennes).

Harengula gibbosa Jordan and Seale (1906) Negros; Jordan and Richardson (1907) Manila.

Harengula sundaica Jordan and Richardson (1907) Manila, Iloilo, Aparri.

Clupea (Harengula) fimbriata Weber and de Beaufort (1913) Philippines.

Clupea (Harengula) fimbriata Deraniyagala (1929) Philippines.

Sardinella fimbriata Fowler (1918) Philippines; Fowler (1927) Bacon; Fowler (1931) Philippines; Herre (1934) Bauang Sur, Manila, Nasugbu, Alabat Islands.

SARDINELLA LONGICEPS Cuvier and Valenciennes.

Sardinella longiceps Fowler (1927) Orion; Herre (1931) Estancia, Culion, Manila market.

SARDINELLA SCHRAMMI (Bleeker).

Harengula schrammi Fowler (1927) Sta. Maria, Vigan, San Fernando; Herre (1934) Dumaguete.

SARDINELLA JUSSIEU (Lacépède).

Sardinella jussieu Fowler (1927) Vigan; Orani, Orion; Philippines.

HARENGULA DISPILONOTUS Bleeker.

Harengula dispilonotus Herre (1931) Cebu; Fowler (1934) Philippines.

HARENGULA TAWILIS Herre.

Harengula tawilis Herre (1927) Lake Taal; Herre (1934) Lake Bombon.

HARENGULA MOLUCCENSIS Bleeker.

Harengula moluccensis Jordan and Seale (1906) Cavite; Evermann and Seale (1906) Bacon, Bulan; Jordan and Richardson (1907) Manila; Seale and Bean (1907) Zamboanga; Herre (1934) Jolo, Dumaguete.

Clupea (Harengula) moluccensis Weber and de Beaufort (1913) Philippines.

Harengula punctata Herre (1934) Unisan, Culion, Dumaguete.

ILISHA HOEVENII Bleeker.

Ilisha hoevenii Evermann and Seale (1906) San Fabian; Jordan and Seale (1906) Cavite; Jordan and Richardson (1907) Manila; Fowler (1918) Philippines; Fowler (1927) Orion, Philippines; Herre (1934) Manila.

Pellona hoevenii Weber and de Beaufort (1913) Philippines.

ILISHA DITCHOA Cuvier and Valenciennes.

Pellona ditchoa Herre (1934) La Paz, Iloilo.

ALEPOCEPHALIDÆ**ALEPOCEPHALUS ANDERSONI** Fowler.

Alepocephalus andersoni Fowler (1934) between Siquijor and Bohol in 392 fathoms.

BATHYTROCTES HATAII Fowler.

Bathytroctes hataii Fowler (1934) east coast of Luzon; in 300 fathoms.

NARCETES LLOYDI Fowler.

Bathytroctes lloydi Fowler (1934) east coast of Luzon, in 565 fathoms.

NARCETES GARMANI Fowler.

Narcetes garmani Fowler (1934) China Sea, vicinity of southern Luzon, in 248 fathoms.

MICROSTOMIDÆ**MICROSTOMA SCHMITTI** Fowler.

Microstoma schmitti Fowler (1934) east coast of Luzon, in 383 fathoms.

STERNOPTYCHIDÆ**POLYIPNUS SPINOSUS** Günther.

Polyipnus spinosus Günther (1887) Sta. 200, between the Philippine Islands and Borneo.

STERNOPTYX DIAPHANA Hermann.

Sternoptyx diaphana Günther (1887) Sta. 214, Philippine Islands.

STOMIATIDÆ**STOMIAS AFFINIS** Günther.

Stomias affinis Günther (1887) Sta. 23, South of Sombbrero Island, Philippines.

MALACOSTEUS INDICUS Günther.

Malacosteus indicus Günther (1887) Sta. 214, near Philippine Islands.

ELAPTEROSTOMIAS PHILIPPINUS Fowler.

Elapterostomias philippinus Fowler (1934) China Sea, vicinity of southern Luzon, in 524 fathoms.

PSEUDOEUSTOMIAS MYERSI Fowler.

Pseudoeustomias myersi Fowler (1934) Sulu Sea, vicinity of southern Panay, in 411 fathoms.

MELANOSTOMIAS STEWARTI Fowler.

Melanostomias stewarti Fowler (1934) Dupon Bay, Leyte.

MELANOSTOMIAS GLOBULIFER Fowler.

Melanostomias globulifer Fowler (1934) west coast of Luzon, in 297 fathoms.

MELANOSTOMIAS VIERECKI Fowler.

Melanostomias vierecki Fowler (1934) east of Masbate, in 604 fathoms.

The following species previously accredited to the Philippine Islands are not represented in the collection of the Fish and Game Administration, Bureau of Science.

Spratelloides gracilis (Schlegel).
Engraulis dussumieri Cuvier and Valenciennes.
Engraulis valenciennesi Fowler.
Etrumeus albulina Fowler.
Stolephorus heterolobus Rüppell.
Sardinella leiogaster Cuvier and Valenciennes.
Sardinella clupeoides (Bleeker).
Sardinella brachysoma (Bleeker).
Sardinella schrammi (Bleeker).
Ilisha ditchoa Cuvier and Valenciennes.
Alepocephalus andersoni Fowler.
Bathytroctes hataii Fowler.
Narcetes lloydi Fowler.
Narcetes garmani Fowler.
Microstoma schmitti Fowler.
Polyipnus spinosus Günther.
Stomias affinis Günther.
Malacosteus indicus Günther.
Elapterostomias philippinus Fowler.
Pseudoeustomias myersi Fowler.
Melanostomias stewarti Fowler.
Melanostomias globulifer Fowler.

Scutengraulis mystax (Bloch) and *Valenciennellus tripunctulatus* (Esmark) are recorded in the Philippines for the first time.

A new species of *Sardinella* is described in this paper.

Key to the Philippine families of the order.

a¹. Lateral line present.

b¹. Gular plate present between branches of lower jaw..... ELOPIDÆ.

b². No gular plate.

c¹. Teeth present ALBULIDÆ.

c². Teeth absent CHANIDÆ.

a². No lateral line.

b¹. No adipose fin; no photophores; parietals present.

c¹. Abdominal edge without scutes.

d¹. Belly carinate, sharp; teeth long; scales very small.

CHIROCENTRIDÆ.

d². Belly rounded, teeth short; scales moderate..... DUSSUMIERIDÆ.

c². Abdominal edge with scutes.

d¹. Mouth small, inferior; maxillary with one supplemental bone;
no teeth DOROSOMIDÆ.

d². Mouth large; maxillary with two supplemental bones; teeth
usually present.

e¹. Snout prominent; mouth usually oblique, maxillary narrow,
may be produced ENGRAULIDÆ.

e². Snout never prominent, mouth horizontal, terminal; maxillary
broad, never produced CLUPEIDÆ.

b². Adipose fin present; photophores present; parietals absent.

STERNOPTYCHIDÆ.

ELOPIDÆ

Body oblong or elongate, more or less compressed. Scales cycloid and silvery. Mouth large and terminal, bounded laterally by maxillaries which have two supplemental bones. Intermaxillaries short and nonprotractile. A gular plate present between mandibular branches. A straight lateral line present. Dorsal slightly behind origin of ventrals; anal far behind dorsal. Pectorals situated low and can be folded like ventrals. Gill rakers 13 to 30. Gill membranes free and separate. Branchiostegals numerous.

This family is represented in the collection by two genera, *Elops* Linnæus and *Megalops* Lacépède, each with one species.

In the genus *Elops*, large pseudobranchiæ are present; the dorsal and the anal are depressible in a scaly sheet; the dorsal is longer than the anal, without produced rays; the scales are small. In the genus *Megalops* no pseudobranchiæ are present; the dorsal and the anal are not provided with a scaly sheet; the dorsal is shorter than the anal, its last ray produced, and the scales are large and heavy.

ELOPS HAWAIIENSIS Regan. Bidbid, awa. Plate 1, fig. 11.

Elops saurus BLEEKER, Atl. Ichth. 6 (1866-1872) 84; MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 594; FOWLER, Proc. Acad. Nat. Sci. Phila. (1900) 496; STEINDACHNER, Denk. Akad. Wiss. Wien 70 (1901) 513; JENKINS, Bull. U. S. Fish Comm. 22 (1902) 432; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 53; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 235.

Elops hawaiiensis REGAN, Ann. & Mag. Nat. Hist. III 8 (1909) 39; GÜNTHER, Journ. Mus. Godeffroy 8 pt. 16 (1910) 386; FOWLER, Proc.

Acad. Nat. Sci. Phila. (1911) 204; WEBER, Fische Siboga Expeditie (1913) 1; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 3; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 256; Mem. B. P. Bishop Mus. 10 (1928) 26.

Elops hawaiiensis FOWLER, Copeia No. 58 (June, 1918) 62; No. 112 (November, 1922) 82; Bull. B. P. Bishop Mus. 22 (1925); HERRE, Fish. Herre 1931 Philip. Exp. (1934) 13.

Head 3.4–3.7; depth 5.5–5.7; dorsal 23–24; anal 15–16; scales 94–97 in lateral line, 22–25 in transverse series, 10–12 above lateral line.

Body elongate, compressed. Head broad, about 3 in its length. Mouth large, oblique, inferior; jaws of equal length. Snout width about its length, equal eye. Maxillary narrow at origin, broad distally, greatest breadth about radius of eye; extends far behind hind margin of eye. Fine villiform teeth on jaws, entire inferior margin of maxillary, tongue, vomer, palatines, and pterygoids. Entire premaxillary teeth exposed when mouth is closed. Length of gular plate less than twice the orbit. Dorsal surface of head furrowed at center; interorbital less than eye. Radiating venules on preopercle and opercle. Four large, thin, soft scales behind occiput, the lateral pair overlapping opercle. About 30 branchiostegals, left wing overlapping right at isthmus. Gill rakers 13 to 15, hard, flattened, with spinous edge; length about equal to gill filament and to radius of eye. Pseudobranchiæ well developed, about 40. Scales minute, rather adherent, with 9 to 15 radii which terminate on basal margin on indentations; posterior margin serrate, crenulate. Scales on lateral line with closed tube on focus.

Origin of dorsal nearer caudal base than snout tip, depressible in scaly sheath; base about equal to postocular part of head, shorter than its height. Anal short, depressible in scaly sheath, shorter than height, slightly longer than greatest width of operculum, well advanced from caudal base. Pectorals equal dorsal base. Ventrals well developed, slightly shorter than pectorals, nearer anal than pectorals and below first fourth of dorsal base.

This description is based on two specimens, Nos. 15137 and 24349, 217 mm and 192 mm long, obtained from Manila December 9, 1926.

MEGALOPS CYPRINOIDES (Broussonet) Buanbuan, bulan-bulan. Plate 1, fig. 4.

Clupea cyprinoides BROUSSONET, Tableau Ichth. Lichtenstein, Forster, Descript. anim. (1844) 296.

- Megalops indicus* BLEEKER, Journ. Ind. Arch. 3 (1849) 67; KNER, Fische Novara Exp. (1865-67) 339.
- Elops cundinga* CANTOR, Journ. Asiat. Soc. Bengal 18 (1850) 1271.
- Megalops macrophthalmus* BLEEKER, Nat. Tijdschr. Ned. Ind. 1 (1851) 421.
- Megalops cyprinoides* GÜNTHER, Cat. Brit. Mus. 7 (1868) 471; BLEEKER, Atl. Ichth. 6 (1866-72) 87; DAY, Fishes of India 4^o. (1878-88) 650; SAUVAGE, Hist. Madagascar 16 (1891) 495; JORDAN and SEALE, Proc. U. S. Nat. Mus. 18 (1905); EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 53; GÜNTHER, Fische der Südsee 8 (1909) 387; WEBER, Fische Siboga Expeditie (1913) 1; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 5; CHAUDHURI, Mem. Ind. Mus. 5 (1916) 417; FOWLER, Copeia No. 58 (June, 1918) 62; Proc. Acad. Nat. Sci. Phila. 79 (1927) 256; SCHMIDT, Pan-Pacific Res. Inst. 5 No. 4 (1930) 2; HERRE, Fish. Herre 1931 Philip. Exp. (1934) 13.
- Megalops macropterus* MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 594.
- Clupea thrissocles* SCHNEIDER, Bloch, Syst. Ichth. (1801) 424.
- Clupea setipinna* VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 286.

Head 3.3-3.6; depth 3.3-3.4; dorsal 17-19; anal 23-25; scales 34-36 in longitudinal series along lateral line; 12 in transverse series, 5 above lateral line; 15-17 predorsals.

Body oblong, compressed, ventral profile more convex than dorsal; belly noncultrate. Head width 2.3 to 2.4 in its length. Mouth large; lower jaw prominent, longer than upper; maxillary large, narrow at fusion with premaxillary, more or less uniformly broad posteriorly and ending bluntly on or slightly behind hind border of eye; length equals preocular part of head minus lower jaw. Snout short, about 1.4 in eye which is large and about 3.4 to 3.5 in head. Minute villiform teeth on jaws, along entire inferior border of maxillary, tongue, palatine, vomer, and pterygoid. Interorbital flat, narrower than snout, equal snout length. Branchiostegals 22 to 24, right wing rolled in, invariably overlapped by left wing at region of isthmus. Gill rakers 30 to 31, longer than filaments, less than radius of orbit, strong, flat, blunt, with spines on inner edge. Scales large, adherent, with peculiar lobate basal margin; with 4 to 8 prominent radii which end posteriorly on indentations of anterior margin; with several indistinct and broken transverse striations which may anastomose with radii; posterior margin thin, crenulate; scales on lateral line with large furrows on exposed portion radiating from foci.

Dorsal origin nearer caudal base than snout tip; last ray produced, not reaching caudal base, 1.7 to 2.2 times dorsal base which is about 1.5 in its height. Anal long, shorter than produced dorsal ray, longer than high; last ray barely reaching caudal base. Pectorals about equal anal base, 1.4 to 1.6 in head. Ventrals about equal dorsal base, nearer anal origin than pectorals, immediately below dorsal origin.

This description is based on No. 10048, 127 mm, obtained from Zambales, October 20, 1921, and No. 15141, 192 mm, obtained from Lake Bombon, Batangas, August 18, 1927.

LUZON, Cagayan Province, Buguey, No. 28186, 124 mm; Pampanga Province, Guagua, No. 15290, 181 mm, April 8, 1927; Macabebe, Nos. 15337, 28193-4, 168 to 183 mm, May 6, 1927; Tarlac Province, Tarlac, No. 4132, 223 mm, 1904; Zambales Province, Iba, No. 10048, 130 mm, October 20, 1921; Bulacan Province, Obando, sitio Pagogo, No. 15335, 143 mm, April 2, 1927; Paombong, No. 15336, 15 mm, April 22, 1927; Rizal Province, Pasay, No. 543, 162 mm, July 7, 1907; Manila, Nos. 302, 162 mm, June 14, 1907; No. 950, 207 mm, September, 1907; Albay Province, Legaspi, Rawis River, Nos. 13075 and 28288-89, 35 to 79 mm, February 2-3, 1926. MINDORO, Mindoro Province, Mangarin Bay, No. 9645, 128 mm, 1913; Puerto Galera, Nos. 10079, 28188-89, 110 to 140 mm, March-May, 1912. GUIMARAS, Iloilo Province, Jordan, Nos. 11630, 28187, 80 to 86 mm, February 7, 1925. NEGROS, Negros Oriental Province, Dumaguete, No. 15971, 55 mm, March, 1913. PALAWAN, Palawan Province, Taytay, Nos. 10079, 28190-92, 90 to 175 mm, May, 1913. BALABAC, Palawan Province, No. 15697, 168 mm, November 17, 1927. CAMIGUIN, Misamis Province, No. 583, 202 mm, July 20, 1907.

ALBULIDÆ

Body elongate, slightly compressed; abdominal surface rounded, not keeled. Head naked. Snout prominent, conical, long, projecting beyond cleft of mouth which is inferior and horizontal. Maxillary edentulous with one supplemental bone. Villiform teeth on jaws, vomer, and palatines; granular teeth on pterygoids, sphenoid, and tongue. Eye large, with broad annular adipose covering. Gular plate wanting. A collar of thin, flappy scales on occiput. Gill membranes separate, free from isthmus. Gill rakers short, granular. Scales small, ad-

herent, cycloid, with a brilliant silvery sheen. Lateral line present. Dorsal slightly in advance of ventrals. Anal short, less than base of dorsal, far behind anus. Caudal deeply forked. Large axillary scales above and below ventrals. Branchiostegals 11 to 16. Pseudobranchiæ well developed.

Genus ALBULA Bloch

For characters of the single genus see those of the family. One Philippine species is known.

ALBULA VULPES (Linnaeus). Plate 1, fig. 12.

- Esox vulpes* LINNÆUS, Syst. Nat. ed. 10 (1758) 313.
Argentina glossodonta FORSKÅL, Descript. anim. (1777) 68; BONNATERRE, Ency. Ichth. (1752-1804) 177; GMELIN, Linn. Syst. Nat. (1748-1804) 1394.
Esox argenteus SCHNEIDER, Bloch, Syst. Ichth. (1801) 395; LICHTENSTEIN, Forster, Descript. anim. (1844) 196, 256.
Synodus argenteus SCHNEIDER, Bloch, Syst. Ichth. (1801) 398.
Clupea Brasiliensis SCHNEIDER, Bloch, Syst. Ichth. (1801) 427.
Amia immaculata SCHNEIDER, Bloch, Syst. Ichth. (1801) 451.
Butirinus bonanus LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 45; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 18 (1848) 345.
Argentina sphyraena LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 366.
Clupea macrocephala LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 426, 428, 460.
Butirinus glossodontus RÜPPELL, Neue Wirbelthiere, Fische (1835-1840) 80; TEMMINCK and SCHLEGEL, Fauna Japon. Poiss. (1842) 242, GÜNTHER, Fish. Zanzibar (1866) 120.
Conorhynchus glossodon BLEEKER, Atl. Ichth. 6 (1866-1872) 83; Versl. Akad. Ams. 2 II, pt. 2 (1868) 300.
Albula conorhynchus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1848) 356; GÜNTHER, Cat. Brit. Mus. 7 (1868) 468; DAY, Fishes of India 4°. (1878-1888) 648; STREETS, Bull. U. S. Nat. Mus. 7 (1877) 76; SCHMELTZ, Cat. Mus. Godeffroy 6 (1877) 18; GÜNTHER, Rept. Voyage "Challenger" 1 (1880) 66; MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 593; 8 (1883) 278.
Albula neoguinaica CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 253.
Albula seminuda CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 254.
Albula erythrocheilus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 254; CANTOR, Journ. Asiat. Soc. Bengal. 18 (1850) 283.
Albula forsteri CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 256.
Albula bananus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 249; BLEEKER, Ichth. Madura, Verh. Bat. Gen. 22 (1849) 11; KNER, Fische Novara Exp. (1865-1867) 339.
Albula glossodonta KLUNZINGER, Fische Rothen Meeres, Verh. z. b. Ges. Wien (1871) 602; STEINDACHNER, Denk. Akad. Wiss., Wien 70 (1901) 513.

Albula vulpes SEALE, Occ. Papers, B. P. Bishop Mus. 1 No. 2 (1902) 15, 18; JENKINS, Bull. U. S. Fish. Com. 22 (1902) 432; SNYDER, Bull. U. S. Fish. Comm. 22 (1902) 521; JORDAN and EVERMANN, Bull. U. S. Fish. Comm. 23 pt. 1 (1903) 55; SEALE, Occ. Papers B. P. Bishop Mus. 4 No. 1 (1906) 5; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 242; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 7; McCULLOCH, Rec. Austr. Mus. (1919) 172; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 4, 23; FOWLER and BALL, Bull. B. P. Bishop Mus. 26 (1925) 5; FOWLER, Bull. B. P. Bishop Mus. 38 (1927) 5; Mem. B. P. Bishop Mus. 10 (1928) 27; SCHMIDT, Pan-Pacific Res. Inst. 5 No. 4 (1930) 2.

Albula glossodon GÜNTHER, Fische der Südsee 3 (1909) 385.

Albula virgata JORDAN and JORDAN, Mem. Carnegie Mus. 10 (1922) 6.

Head 3.4–3.7; depth 4.3–4.6; dorsal 17; anal 7; scales 66–71 along lateral line, 6–7 behind caudal base; 17–18 on transverse series below origin of dorsal, 9 above lateral line, 25–27 predorsals.

Body elongate, slightly compressed, sometimes subcylindrical. Dorsal profile more convex than ventral, latter sometimes nearly straight. Caudal peduncle slightly compressed, length about equal to its least width, 4 in head. Head conical, terminating acutely. Snout prominent, heavy, long, 2.5 in head, broad behind, narrow anteriorly, greatest breadth 1.2 in its length. Maxillary barely reaches front margin of eye, slightly less than length of snout, superior portion hidden below preopercle, inferior portion thick with adipose tissue, exposed. Lower jaw pointed, not prominent, shorter than upper jaw, wedged between maxillaries. Villiform teeth on jaws, vomer, and palatines; strong, granular teeth on tongue, pterygoids, and sphenoid; the toothed portion of tongue elevated, wedged between protruding pterygoids and depressed sphenoid. Eye 5.4 in head, with thick adipose eyelid. Top of head wide, flat, straight, descending, covered with thick adipose membrane; tuberculate at posterior portion. Interorbital wide, 1.3 times orbit. Radiating venules on preopercle originating from posterior margin of eye. Cheek and preorbital with fine tubercles. Inferior margin of cheek immediately behind maxillary, lined with 7 to 9 subcircular scales, which are firmly attached to each other, smaller than body scales, with a central focus; anterior margin indented with two radii; anterior portion tuberculate. An occipital collar of thin, soft, scales, those on extreme lateral sides partly overlapping edge of opercular opening. Gill rakers 8 to 9, reduced to knob-shaped structure; gill filaments about 1.4 in head. Pseudobranchiæ about 40. Branchiostegals 13. Scales

adherent, regularly arranged, rather small, unimbricated portion silvery, with thin, wide, flabby, crenulate membrane bordering on smoothly convex hind margin; anterior margin more or less straight, with 4 to 6 prominent indentations, 2 to 4 radii arising from focus; posterior portion with horizontal rows of minute, pearly tubercles which lose linear arrangement toward focus. Scales on lateral line with convexity of posterior margin disturbed by the single lateral line tube. Lateral line nearly straight.

Dorsal origin about midway between snout tip and caudal base; base slightly shorter than height, which equals head minus snout; rays with a flap of scales each, which overlaps succeeding ray behind, partly imbricating next scaly flap. Anal small, base shorter than height, slightly longer than orbit. Pectorals well developed, about equal base of dorsal, extend slightly in front of origin of dorsal. Ventrals equal snout, with well-developed superior and inferior axillary scales. Membranes between rays of pectorals, ventrals, and anal with small, silvery scales.

Brilliant silvery all over. Dorsal portion of head light brown. A brownish black spot in front of nostril; a transverse band of similar color before tip of snout.

This description is based on No. 16219, 285 mm, collected from Cadiz Nuevo, Occidental Negros, August, 1929.

The only other specimen of the species in the collection (No. 16002), was obtained by S. T. Trawler "Los Pescados" from Mekong River, Tibet, in southern Asia.

CHANIDÆ

Body oblong, somewhat compressed, head depressed. Scales cycloid, small, adherent, longitudinally striped. Mouth terminal, small, and bordered above only by the intermaxillaries. Maxillaries without supplemental bone. Mandibles with a symphy-sial tubercle which fits into a notch between the intermaxillaries. Teeth absent. Dorsal opposite ventrals, which are longer than anal. Ventrals well developed, with 11 or 12 rays. Caudal forked. Gill membranes totally united, free from isthmus; 4 branchiostegals; pseudobranchiæ well developed; gill rakers in two diverging rows, very fine and numerous.

This family is represented by *Chanos chanos* Forskål, the only species in the Philippines.

CHANOS CHANOS (Forskål). Baños. Plate 1, fig. 3.

Mugil chanos FORSKÅL, Descript. anim. (1775) 14, 74.

Mugil salmoneus (Forster) (SCHNEIDER, Bloch, Syst. Ichth. (1801) 421; LICHTENSTEIN, Forster Descript. anim. (1884) 299.

Chanos cyprinella EYDOUX and SOULEYET, Voy. "Bonite" Zool. 1 (1841) 196.

Chanos orientalis EYDOUX and SOULEYET, Voy. "Bonite" 1 (1841) 196.

Chanos salmoneus CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 146; BLEEKER, Arch. Neerl. Sci. Nat. 13 (1878) 38; GÜNTHER, Rep. Voyage "Challenger" 1 (1880) 61; MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 594; VAILLANT, Bull. Soc. Philom. Paris VII 11 (1886-87) 53.

Chanos chloropterus KNER, Novara Exp. Fische 1 pt. 5 (1865) 341.

Chanos orientalis SCHMELTZ, Cat. Godeffroy Mus. 4 (1869) 25.

Chanos chanos STEINDACHNER, Denk. Akad. Wiss., Wien. 70 (1901) 514; JENKINS, Bull. U. S. Fish Comm. 22 1902 (1903) 432; JORDAN and SCHNEIDER, Proc. U. S. Nat. Mus. 28 (1904) 124; JORDAN and EVERMANN, Bull. U. S. Fish Comm. 23 pt. 1, 1903 (1905) 56; JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1905) 186; 26 (1906) 4; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236; EVERMANN and SEALE, Proc. U. S. Nat. Mus. 31 (1907) 505; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 239; GÜNTHER, Journ. Godeffroy Mus. 8 pt. 16 (1909) 387; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 243; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 15; CHAUDHURI, Mem. Indian Mus. 5 (1916) 417; FOWLER, Bull. B. P. Bishop Mus. 22 (1925) 23; 38 (1927) 5; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 256; SCHMIDT, Pan-Pacific Res. Inst. 5 No. 4 (1930) 3.

Head 3.8-4; depth 3.4-3.8; dorsal 12-13; anal 8; scales 76-82 in median lateral line series; 32-36 in transverse series; 31-34 predorsals.

Body moderately elongated and compressed; dorsal profile slightly more convex than ventral which is rounded, broadened, especially on thoracic portion. Caudal peduncle rather long, about 2.3 in head, greater than least depth. Head width greater than twice length. Snout width greater than its length, equals eye diameter, undershot to a conical point. Eye large, twice nearer to snout tip than to posterior margin of operculum, 3.2 to 3.5 in head, with thick adipose eyelid. Mouth small; maxillary barely reaching front margin of eye, partly hidden below preorbital, toothless. Lower jaw slightly shorter than upper jaw, tightly wedged between rami of maxillary. Vertex low, concave, broad, greater than greatest diameter of eye, less than 3 in head; often covered with a thick adipose membrane. Nape

high, greatly convex, broad. Gill membranes completely united below. Branchiostegals 4, cemented together. Gill rakers 240 to 252, lanceolate, slender, smooth, short, one-third of gill filament, which is longer than half orbit. Scales regularly imbricated, strongly adherent, small, with length slightly greater than width; basal margin with a deep, cuneiform notch at middle portion; 25 to 39 longitudinal striæ on unimbricated portion, which terminate at posterior margin where each forms the pinnacle of serrature; focus central, distinct; circuli fine, circularity disturbed by basal notch to which they conform; discontinuous due to posterior striæ; no transverse striations. Lateral line straight except for anterior part which rises to summit of operculum.

Dorsal origin equidistant from front margin of orbit and caudal base; base sheltered in flaps of two rows of alar scales, 1.5 in length of longest ray which is 3 in distance of dorsal origin to snout tip, last ray much branched, ultimate branch longest. Caudal deeply forked, lobes much longer than head; directed slightly upward. Pectorals 1.5 in head; first ray large, strong, origin overlapped by margin of gill membrane. Ventrals well developed, slightly smaller than pectoral, equal dorsal base, 1.8 in head; origin nearer pectorals than caudal, base about below middle of dorsal; axillary scale well developed, tapers posteriorly, 1.7 in ventrals. Anal short, base less than height, about a snout length, somewhat protracted; rays, for a large part, enveloped in scaly sheaths.

Description based on Nos. 307 (261 mm) and 639 (307 mm) from Manila market, June 17 and August 4, 1927, respectively.

LUZON, Pampanga Province, Macabebe, No. 15414, 125 mm, May 6, 1927; Macabebe, No. 21155, 168 mm, May 6, 1927; Rizal Province, Malabon, Dampalet, Nos. 15264, 21158-62, 34-38 mm, May 8, 1927; Malabon, Tonsuya, No. 15245, 161 mm, March 30, 1927; Malabon, Nos. 21165-70, 43-55 mm, April 17, 1928; Manila, Manila market, No. 55393, 298 mm, July 8, 1927; Manila market, No. 951, September, 1907: Cavite Province, Cavite, Nos. 26993-97, 49-65 mm, September 27, 1927. PANAY, Iloilo Province, Dumangas, Nos. 15485, 21154, 176 and 218 mm, August 3, 1927; Jaro, No. 45481, 124 mm, August 14, 1927. BANTAYAN, Cebu Province, No. 5922-23, 111-125 mm, May, 1909. MACTAN, Cebu Province, Opon, No. 15443, 169 mm, August 27, 1927. BOHOL, Bohol Province, Kagtong, No. 14804, 143 mm, November 25, 1926. PALAWAN, Palawan Province, (Panacan, Paragua,

Nos. 5311, 21164, 226 mm, August 14, 1908. BUNGAU, Sulu Province, Bungau, Nos. 21156-57, 10779, 59-80 mm, September 7, 1923.

CHIROCENTRIDÆ

Body very long and compressed. Scales thin, small, and very deciduous. Abdomen with sharp margin but without scutes. Mouth large, very oblique, bordered by large intermaxillaries and long narrow maxillaries with two supplemental bones. Mandibulars very prominent, teeth on mandibulars and median portion of intermaxillaries caninoid; those in other parts of the jaws are long and pointed, few teeth on palatines and tongue. Eyes small, subcutaneous. Dorsal above anterior part of very long anal. Ventrals very small, midway between caudal base and tip of snout. Pectorals situated low, folding like ventrals. Gill membranes separate, free; branchiostegals 8; gill rakers very short, strong, flattened, 13; no pseudobranchiæ.

This family is represented in the Philippines by one genus.

Genus CHIROCENTRUS Cuvier

The characters of the genus are the same as those of the family. One Philippine species is known.

CHIROCENTRUS DORAB (Forskål). Parang-parang. Plate 1, fig. 9.

Clupea dorab FORSKÅL, Descript. anim. (1775) 72; CUVIER and VALENCIENNES, Hist. Nat. Poiss. 19 (1846) 110; JOUAN, Mem. Soc. Cherbourg 18 (1861) 306; 21 (1877-78) 335.

Chirocentrus dorab BLEEKER, Atl. Ichth. 6 (1866-72) 92, 271; BLEEKER, Versl. Akad. Amsterdam 2 ser. II (1868) 300; PETERS, Monatsb. Akad. Wiss. Berlin 1876 (1877) 846; MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 594; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 4; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 53; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236; GÜNTHER, Journ. Godeffroy Mus. 8 pt. 16 (1909) 388; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 18; FOWLER, Copeia No. 58 (June, 1918) 62; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 (1922) 2; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 256.

Head 5.7; depth 6; dorsal 16; anal 30. Body very elongate, strongly compressed; depth almost uniform from insertion of pectorals to anal; ventral profile sharp, nonserrate, with hairlike appendages in a single row from pectorals to anal. Caudal peduncle long, deep, length slightly greater than least depth, 2 in head measured from tip of lower jaw. Head small, well compressed, width 3.6 in its length, directed dorsally and anteriorly

so that the tip of snout rises above level of dorsal profile; shallow notch at junction of nape and vertex. Mouth large, oblique; lower jaw well protracted, longer than upper jaw. Maxillary reaches to below middle of eye; upper lip fold produced anteriorly into a small mesial flap which ends acutely and finds support on a pair of horizontal, sharp canines on the small premaxillary. Entire margin of maxillary armed with small, firm, sharp, teeth which become smaller and closely set towards posterior edge. Six to nine pairs of canine teeth on mandible, compressed, sharp, directed posteriorly, slightly upward. Tips of maxillary and mandible do not meet, leaving mouth slightly gaping and leaving first three to five pairs of mandibular canines and the single pair of maxillary canines exposed. Snout greater than orbit, less than four times head with lower jaw. Teeth on palatine, pterygoid, and tongue. Eye slightly advanced. Interorbital flat, about one orbit. Cheek, preopercle, and postorbital with extensive venation. Gill opening wide. Branchiostegals small, well hidden inside rami of mandible. Gill rakers 14, short, flat, blunt, toothed on inside edge, widely spaced, shingled flat on arch, about half filament which is shorter than orbit. Scales small, very deciduous, entire, regular, with fine circuli, without transverse striations. Dorsal low, situated far back, about 2.5 nearer to caudal base than to snout tip; slightly in front of anal which is long, more than twice dorsal base. Pectorals well developed, 1.4 in head, less than twice anal base; first ray strong, stout, compressed, with flat sides at right angle with body; ventral and dorsal axillary scales well developed. Dorsal 1.5 in pectorals. Ventrals much reduced, less than orbit; 1.6 nearer to anal origin than to pectorals; axillary dorsal scale longer.

The above description is based on No. 11597, 406 mm, obtained from Manila, December 23, 1924.

LUZON, La Union Province, Rabon, Rosario, Nos. 12482, 14334, 190 and 341 mm, July 27, 1925; Pangasinan Province, San Fabian, No. 4180, 354 mm, 1904; Manila, Manila market, No. 559, 295 mm, July, 1907; No. 11674, 282 mm, February 23, 1925; Camarines Sur Province, San Miguel Bay, No. 9524, 352 mm, December 19, 1918; Caiabanga, Nos. 11578, 13219, 21174-5, 237-277 mm, January 16, 1926; San Miguel, Nos. 21176-7, 166-257 mm, December 19, 1918. TABLAS, Romblon Province, Tablas, Nos. 10149, 21173 and 162, 174 mm, January, 1923. SAMAR, Samar Province, Buguey, No. 14796, 322 mm, December

SPRATTELLOIDES DELICATULUS (Bennett).

- Clupea delicatula* BENNETT, Proc. Comm. Zool. Soc. 1 (1831) 168.
Clupea macassariensis BLEEKER, Journ. Ind. Arch. 3 (1849) 72.
Clupeoides macassariensis BLEEKER, Verh. Bat. Gen. 24 (1852) 17.
Spratelloides delicatulus GÜNTHER, Cat. Brit. Mus. 7 (1868) 464;
BLEEKER, Atl. Ichth. 6 (1866-1872) 96; SCHMELTZ, Cat. Mus. Godefroy 5 (1874) 37; GÜNTHER, Fische der Südsee 3 (1909-1910) 383.
Stolephorus delicatulus JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 186; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 53; SEALE, Occ. Papers B. P. Bishop Mus. 4 No. 1 (1906) 5; KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 25 (1911) 243; FOWLER, Occ. Papers B. P. Bishop Mus. 8 No. 7 (1923) 375; Bull. B. P. Bishop Mus. 22 (1925) 4; FOWLER and BALL, Bull. B. P. Bishop Mus. 26 (1925) 5; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 256; Mem. B. P. Bishop Mus. 10 (1928) 29.

Head 4-4.4; depth 5.3-6; dorsal 11-12; anal 9-10; scales 35-37 on median lateral series, 7-8 on transverse series; predorsals 12-14.

Body elongate, moderately compressed; dorsal and ventral sides rounded. Snout conical, longer than eye which is about 4 in head. Maxillary reaches to front margin of eye. Interorbital less than eye, flat, nonvenulose. Prominent venules on cheek, preopercle, and opercle; characteristic black venules on preorbital just behind superior margin of maxillary. Gill rakers 22 to 26, finely lanceolate, slightly longer than gill filaments, shorter than eye. Scales deciduous, with 3 to 7 transverse striæ, all continuous, regular, posterior margin sometimes slightly and irregularly serrate. Dorsal origin nearer snout tip than caudal base; base depressed, much shorter than height, which equals head minus snout. Anal low, short, inserted about midway between caudal base and ventral origin. Pectorals slightly longer than postocular part of head, not reaching ventral, which is longer than eye and inserted below middle of dorsal, midway between pectorals and anal.

The above description is based on the 2 largest of 25 specimens bearing No. 2975, ranging in size from 31 to 53 mm, collected from Bacon, Sorsogon, 1904.

Genus DUSSUMIERIA Cuvier and Valenciennes

Body rather elongate, more or less compressed; abdomen rounded, not serrate. Scales of moderate size, deciduous; no lateral line. Snout pointed; upper jaw not projecting; cleft of mouth of moderate width. Form of mouth like that of *Clupea*. Jaws with small, fixed, nondeciduous teeth; patches of villiform

teeth on palatine, pterygoid, and tongue, but absent from vomer. Dorsal fin opposite ventral; anal moderate in length. Gill membrane with numerous very fine branchiostegals; pseudobranchiæ well developed.

Key to the Philippine species of Dussumieria.

α^1 . Scales 40 to 42 in median lateral series.

D. acuta Cuvier and Valenciennes.

α^2 . Scales 52 to 56 in median lateral series..... *D. hasseltii* (Bleeker).

DUSSUMIERIA ACUTA Cuvier and Valenciennes. Tullis. Plate 1, fig. 5.

Dussumieria acuta CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 343; CANTOR, Journ. Asiat. Soc. Bengal 18 (1850) 1268; KNER, Fische Novara Exp. (1865-1867) 330; GÜNTHER, Cat. Brit. Mus. 7 (1868) 466; DAY, Fish. Malabar (1865) 226; BLEEKER, Atl. Ichth. 6 (1866-1872) 647; MACLEAY, Proc. Linn. Soc. N. S. W. 3 (1883) 278; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 21; FOWLER and BEAN, Proc. U. S. Nat. Mus. 62 art. 2 (1923) 2; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 30; DERANIYAGALA, Spolia Zeylanica 15 (1929) 33; Ceylon Journ. Sci. 5 (1833) 82.

Dussumieria elopsoides BLEEKER, Ichth. Madura, Verh. Bat. Gen. 22 (1849) 12; Versl. Akad. Ams. 2 ser. II (1868) 300; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 5; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236.

Dorsal 19-22; anal 14-17; pectoral 14-15; ventral 8; scales in median lateral series 40-42; scales in transverse series 11-12; head 3.5-3.8; depth 4.1-4.6; predorsal scales 18-19; pre- and postventral scutes indistinct.

Body elongate, moderately compressed, fusiform, dorsal and ventral profile evenly convex; symphysis to ventral fin evenly convex, dorsal profile of head with vertex straight. Caudal peduncle moderately compressed, least depth 1.5 to 3 in its length. Head width 1.6 in its length; snout width 1.2 in its length, 2.3 to 3 in head. Eyes 3.6 in head. Lower jaw longer and more prominent than upper. Maxillary 2.3 in head not reaching below front margin of eye. Teeth on jaws, tongue and palate, but not on vomer. Interorbital flat, slightly concave, with a ridge at middle, 4.3 in head; no venation on vertex. Cheek without large prominent striæ; no venation on post-, pre-, and subopercle. Gill rakers 22 to 24, finely lanceolate, with very fine spines along inner side, about 2 in eye, practically equal to branchial filaments in length. Scales thin, deciduous, their hind margin indistinctly crenulate. Elongated scales on axil of pectorals and ventrals. Scales with 9 striæ, all broken; circuli fine, parallel.

Dorsal depressible in scaly sheaths, its origin much nearer to caudal than to tip of snout, its branched ray 2 to 2.5 in head. Caudal deeply forked. Pectoral depressible in basal scaly flaps, 1.5 in head; ventral 2 in pectoral; axillary ventral scale from 2.3 to 2.5 in pectoral. Ventral inserted beneath last half of dorsal; ventral 2.5 to 3 in head. Origin of anal far behind dorsal, about as long as postorbital part of head, shorter than ventrals; ultimate anal ray well developed.

This description is based on No. 89, 83 mm, and No. 6862, 130 mm, from Manila market, June 10, 1910.

LUZON, Bataan Province, Orani, No. 23967, 52 mm, April 29, 1923; Manila, Manila market, No. 61, 118 mm, May 25, 1907; Nos. 89-91, 82-108 mm, May 31, 1907; No. 159, 110 mm, June 7, 1907; Nos. 6858-59, 117 mm, June, 1910; Nos. 6860-68, 85-130 mm, June, 1910; No. 21241, 65 mm, June, 1910.

DUSSUMIERIA HASSELTII Bleeker. *Tulis*. Plate 1, fig. 2.

Dussumieria hasseltii BLEEKER, *Nat. Tijdschr. Ned. Ind.* 1 (1851) 422; *Verh. Bat. Gen.* 24 (1852) 13; *Atl. Ichth.* 6 (1866-1872) 95; DAY, *Fishes of India* 4°. (1878-1888) 647; JORDAN and RICHARDSON, *Bull. U. S. Bur. Fish.* 27 (1907) 236; WEBER and DE BEAUFORT, *Fish. Indo-Austr. Arch.* 2 (1913) 23; FOWLER, *Copeia* No. 58 (June, 1918) 62; *Proc. Acad. Nat. Sci. Phila.* 79 (1927) 256.

Dussumieria elopsoides GÜNTHER, *Cat. Brit. Mus.* 7 (1868) 466 (nec Bleeker); JORDAN and RICHARDSON, *Bull. U. S. Bur. Fish.* 27 (1907) 236.

Dorsal 18-20; anal 16; pectoral 14-15; ventral 8; scales 52-56 in median lateral series; 12-13 in transverse series; head 3.3-3.6; depth 4.1-4.5; predorsal scales 18-21; pre- and postventral scutes indistinct.

Body elongate, more or less compressed, fusiform; dorsal and ventral profile evenly convex; symphysis to ventral fin convex. Caudal peduncle moderately compressed, its least depth 1.5 in its length; 3 in head. Head width 1.5 in its length; snout width equal length, about 3 in head. Eye about 3.5 to 4 in head. Lower jaw longer and more prominent than upper. Maxillary nearly reaching below front margin of eye, 2.3 to 2.5 in head; teeth on jaw, palatines, pterygoids, and tongue. Interorbital flat, slightly concave with a ridge at middle, 4.5 in head, vertex without venation. Cheek without large prominent striæ, and no venation on post-, pre-, and subopercle. Gill rakers 22 to 24, finely lanceolate, with very fine spines along inner side, about 2.1 in eye, slightly longer than branchial filaments; pseudo-

branchiæ 19. Scales thin, deciduous, crenulate, and entire, with 11 to 15 striæ, 2 to 8 unbroken; circuli fine, elongate scales at axil of pectorals and ventrals. Origin of dorsal more than eye diameter nearer caudal than snout. Dorsal depressible in basal scaly sheaths, the first branched ray 3 in head. Caudal deeply forked. Pectoral depressible in basal scaly flaps, 1.6 to 2 in head; ventral 2; axillary ventral scale 2 to 2.3. Origin of ventral below middle of dorsal, 1.4 in head. Origin of anal far behind dorsal as long as postorbital part of head, shorter than ventral; ultimate ray well developed.

The above description is based on No. 21262, 117 mm, obtained from Barrio Sibubu, Camarines Sur, January 17, 1926.

LUZON, La Union Province, Rosario, Barrio Rabon, No. 12456, 84 mm, July 25, 1925; Tayabas Province, Unisan, Nos. 14850, 21216-17, 75-78 mm, February 15, 1924; Camarines Sur Province, San Miguel Bay, No. 11687, 122 mm, November 11, 1924; Nos. 21225-29, 93-103 mm, July 11, 1924; Barrio Sibubu, Nos. 13241, 21260-64, 112-122 mm, January 17, 1926. SAMAR, Samar Province, San Pedro Bay, near Basey, Nos. 12364, 21230-34, 111-114 mm, September 17, 1925. PANAY, Antique Province, Culasi, Nos. 41117, 41309-10, 88-109 mm, December 15, 1933. GUIMARAS, Iloilo Province, west side of Guimaras Island, Nos. 41312-13, 43-74 mm, December 10, 1934.

DOROSOMIDÆ

Body short, deep, strongly compressed. Scales thin, more or less adherent. Abdominal scutes keeled, spiny. Snout conical, prominent, mouth small, inferior, bordered by intermaxillaries only; maxillaries narrow, with one supplemental bone; no teeth. Eye with adipose eyelid. Dorsal opposite ventrals; anal rather long; pectorals and ventrals moderate; caudal forked. Gill membranes separate, free; branchiostegals 5 to 6; gill rakers short, slender, numerous; pseudobranchiæ large.

Key to the Philippine genera of the Dorosomidæ.

- α^1 . Edge of dentary not reflected at angle of mouth, before end of maxillary; hindmost dorsal ray produced into a filament..... *Clupanodon*.
- α^2 . Edge of dentary reflected outward at angle of mouth, before end of maxillary.
 - b^1 . Last dorsal ray prolonged into a filament; maxillary slightly expanded terminally and curved downward..... *Nematalosa*.
 - b^2 . Last dorsal ray not prolonged into a filament; maxillary a straight, thin, transversely expanded plate, tapering..... *Anodontostoma*.

Genus NEMATALOSA Regan

Mouth toothless, subterminal or inferior, transverse, its cleft forming an angle; dentary edge reflected outwards in front of end of maxillary; one supplemental maxillary bone present; scales 44 to 50 in median lateral series, 14 to 21 in transverse series; dorsal rays 13 to 18; anal 18 to 24; ventral with 8 rays, below or little before dorsal.

There is one Philippine species of this genus.

NEMATALOSA NASUS (Bloch). Suagan. Plate 1, fig. 1; Plate 3, fig. 2.

Clupea nasus BLOCH, *Ausl. Fische* 9 (1795) 116.

Chatoessus nasus CUVIER and VALENCIENNES, *Hist. Nat. Poiss.* 21 (1848) 76; BLEEKER, *Verh. Bat. Gen.* 24 (1852) 50; GÜNTHER, *Cat. Brit. Mus.* 7 (1868) 407; DAY, *Fishes of India* 4° (1866-72) 142; RAMSAY and OGILBY, *Proc. Linn. Soc. N. S. W.* 1 (1886) 8. *Chatoessus selangkat* KNER, *Novara Exp. Fische* (1865-67) 337 (nec Bleeker).

Dorosoma nasus BLEEKER, *Atl. Ichth.* 6 (1866-72) 142; WEBER and DE BEAUFORT, *Fish. Indo-Austr. Arch.* 2 (1913) 24; DERANIYAGALA, *Spolia Zeylanica* 15 (1929) 45.

Konosirus thrissa JORDAN and SEALE, *Proc. Davenport Acad. Sci.* 10 (1905) 2 (not *Clupea thrissa* Linnæus); EVERMANN and SEALE, *Bull. U. S. Bur. Fish.* 26 (1906) 54; HERRE, *Fish. Herre* 1931 *Philip. Exp.* (1934) 15.

Konosirus nasus JORDAN and HERRE, *Proc. U. S. Nat. Mus.* 31 (1906) 625; SEALE and BEAN, *Proc. U. S. Nat. Mus.* 33 (1907) 239.

Clupanodon thrissa FOWLER, *Mem. B. P. Bishop Mus.* 10 (1928) 32.

Nematalosa nasus HERRE, *Fish. Herre* 1931 *Philip. Exp.* (1934) 15.

Head 4-4.2; depth 2.2-2.3; dorsal 15-17; anal 21-23; scales 40-45 in median lateral series; 18-19 in transverse series; 18 predorsals; abdominal scutes, 18 preventral, 11-12 postventrals.

Body oblong, deep, strongly compressed; belly cultrate, lined by spinous and firm scutes which become less trenchant anteriorly. Profiles greatly convex, dorsal uniform; ventral acute from pectorals to anal. Head small, width about 1.7 its length; snout shorter than eye which is 3.3 to 3.5 in head. Maxillary slender, expanded terminally and curved downward, its greater portion hidden beneath preorbital and premaxillary; reaches to below middle of pupil. Interorbital wide, equals eye; tuberculate, slightly convex; with a slightly prominent keel; margin of vertex finely serrate; venules on cheek and preopercle. Gill rakers 135 to 139; very finely lanceolate, smooth, 1.4 in gill filaments, about 3 in head. Pseudobranchiæ prominent, 22 to 25. Scales adherent, wider than long; with one characteristic transverse continuous stria, which may be wavy; posterior margin serrate with indistinct crenulations; basal margin smooth.

Dorsal origin nearer snout than caudal base; base submerged in scaly sheaths, less than height, last ray in adult prolonged along dorsal margin reaching to caudal base; fragile, setiform, about equal to body depth, about 3 times dorsal base; not prolonged, however, in specimens less than 100 mm long. Anal long, equals head without snout, about 2 in body depth; last ray reaches to first third caudal; height 2.5 in base. Pectorals high, about equal head; first ray strong, stout; reaches to about insertion of ventrals. Ventrals 1.6 in pectorals, slightly less than twice orbit, equidistant from pectorals and anal measured from origin to origin. Caudal 2.7 in body length. With a characteristic black spot on shoulder.

The above description is based on No. 4311, 154 mm, Zamboanga, June 3, 1908; No. 5347, 151 mm, and No. 5348, 145 mm, Panacan, Palawan, August 16, 1908.

This species is easily confused with *Clupanodon punctatus*, in having the last dorsal ray produced, and in having similar head and fins. Besides differing in the structure of the maxillary, the two species differ by the following characters: Depth of *Nematalosa nasus* about 2 or slightly more than 2; *C. punctatus*, 3 or more. Scales in longitudinal series, about 40 in *N. nasus*, about 50 in *C. punctatus*; transverse scales, 18–19 in *N. nasus*, 20–23 in *C. punctatus*. Scales similar in that both have the characteristic single uninterrupted transverse striæ; but the scales of *N. nasus* have the posterior edge serrate, in *C. punctatus* the edge is smooth, rarely serrate.

The above differentiation of the two species is made possible by the presence of two specimens of *C. punctatus*, Nos. 10388 and 23053, from Amoy, China.

LUZON, Pampanga Province, Macabebe, Pilipit, Nos. 15326, 23043, 86–88 mm, May 7, 1927: Zambales Province, Iba, No. 11957, 80 mm, October 26, 1921: Manila market, No. 410, 162 mm, June 27, 1907; Manila Bay, No. 41250, 150 mm, October 20, 1929: Rizal Province, Malabon, No. 713, 170 mm, July 18, 1907; Nos. 15300, 110 mm, April 30, 1927; No. 15305, 110 mm, March 31, 1927: Sorsogon Province, Bacon, No. 23052, 167 mm, 1904: Albay Province, Legaspi market, No. 11820, 180 mm, September 21, 1924. PANAY, Antique Province, San Jose, No. 13145, 57 mm, 1926; No. 23053, 50 mm, 1927: Iloilo Province, Dumangas, Nos. 15451, 23562, 71–60 mm, August 5, 1927; La Paz, No. 15455, 73 mm, August 6, 1927; Molo, No. 15468, 96 mm, August 5, 1927.

PALAWAN, Palawan Province, Panacan, Paragna, Nos. 5348, 150 mm, August 16, 1908; Barrio Guinlo, Malampaya Sound, Nos. 15640, 23048-49, 112-117 mm, April 26, 1927. MINDANAO, Zamboanga Province, Zamboanga, No. 4311, 150 mm, June 3, 1908.

Genus ANODONTOSTOMA Bleeker

Supplemental maxillary very slender; scales 40 to 42 in median lateral series, 12 to 17 in transverse series; dorsal rays 17 to 19 with broad basal scaly sheath extending to end of last ray; anal rays 18 to 21 and depressible in scaly sheath; ventral with 8 rays, below middle or front half of dorsal.

ANODONTOSTOMA CHACUNDA (Hamilton-Buchanan). Cabase. Plate 1, fig. 13; Plate 3, fig. 1.

Chupanodon chacunda HAMILTON-BUCHANAN, Fishes Ganges (1822) 246.

Gonostoma javanicum VAN HASSELT, Algemeene Konst en Letterbode (1823) 329.

Chatoessus chacunda CUVIER and VALENCIENNES, Hist. Nat. Poiss. 21 (1848) 81; CANTOR, Journ. Asiat. Soc. Bengal 18 (1850) 1293; BLEEKER, Verh. Bat. Gen. 24 (1852) 46; KNER, Fische Novara Exp. (1865-1867) 337; GÜNTHER, Cat. Brit. Mus. 7 (1868) 411; DAY, Fishes of India 4^o. (1878-1888) 632.

Anodontostoma hasseltii BLEEKER, Verh. Bat. Gen. 22 (1849) 15; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 32.

Chatoessus selangkat BLEEKER, Verh. Bat. Gen. 24 (1852) 47.

Dorosoma chacunda BLEEKER, Atl. Ichth. 6 (1866-1872) 143; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 25.

Dorosoma indicus CHAUDHURI Mem. Indian Mus. 5 (1916) 419.

Anodontostoma chacunda FOWLER, Hongkong Nat. 2 (1931) 79; HERRE, Fish. Herre 1931 Philip. Exp. (1934) 15.

Head 3.5-3.8; depth 2.0-2.2; dorsal 18-19; anal 18-19; scales 35-38 in longitudinal series; 13-14 in transverse series; 13-15 predorsals; abdominal scutes, 16-17 preentrals, 10-12 post-entrals.

Body oblong, strongly compressed, deep. Profiles greatly convex; belly less trenchant anteriorly, with spiny scutes. Head small, width 1.8 to 1.9 in its length; snout heavy, shorter than eye which is 3.4 to 3.6 in head. Maxillary straight, thin, transversely expanded and tapering terminally; reaches to slightly past front margin of pupil. Interorbital about eye diameter, slightly convex, keeled at center, with thick adipose covering. Venations on cheeks. Gill rakers 74 to 78, fine, smooth, flattened, shorter than gill filaments. Pseudobranchiæ 16 to 18. Scales adherent, large, wider than long, with 4 to 7 transverse

striæ, 1 to 2 of which are usually continuous; posterior margin "ctenoid," with pseudospines; basal margin smooth.

Dorsal origin nearer to caudal base than to snout tip; last ray not produced, base longer than height, about head minus snout. Anal rather long, about 1.6 in head, 2.6 to 2.8 in body depth, equals length of operculum; last anal ray barely, if at all, reaching base of caudal, height 6.6 to 6.8 in base. Pectorals high, slightly less than head; first ray well developed, strong. Ventrals about preocular part of head, midway between pectorals and anal measured from origin to origin. Caudal 2.7 to 2.8 in body length. With a characteristic black spot, less than eye, on shoulder.

This species is easily differentiated from *N. nasus* by the absence of a prolonged setiform dorsal ray which is characteristic of the latter. This alone does not separate the two species of sizes below 100 mm as it is equally undeveloped in both. *A. chacunda*, however, has 13 to 14 scales in the transverse series, the scales are larger, with 6 to 8 transverse striæ, and there are less than 100 gill rakers.

The above description is based on No. 14795, 135 mm, No. 23050, 139 mm, and No. 23151, 133 mm, obtained from Basey, Samar, December 6, 1926.

LUZON, La Union Province, Rosario, Barrio Damortis, Nos. 14320, 23047, 99–94 mm, August 3, 1926; Barrio Rabon, No. 12453, 137 mm, August, 1926: Bataan Province, Orani, No. 11311, 114 mm, April 29, 1923: Rizal Province, Malabon, No. 714, 182 mm, June 18, 1907: Manila, Manila market, Nos. 13–15, 99–105 mm, May 21, 1907; No. 139, 113 mm, June 12, 1907; No. 312, 108 mm, June 17, 1907; No. 972, 100 mm, September, 1907: Camarines Sur Province, San Miguel Bay, Nos. 10433, 23043–46, 69–105 mm, January 3, 1919; Calabanga, Nos. 13243, 23033–36, 99–165 mm, January 16, 1926. MINDORO, Mindoro Province, Mangarin, Nos. 11032, 23041, 118–91 mm, 1913. MASBATE, Masbate Province, Guinobatan, No. 1061, 97 mm, August 30, 1902. LEYTE, Leyte Province, Tacloban, No. 1190, 124 mm, September 24, 1907; No. 9579, 134 mm, May 7, 1921; Carigara, No. 7888, 123 mm, December 11, 1913. SAMAR, Samar Province, Basey, Nos. 14795, 23050–51, 51–127 mm, December 2, 1926. PANAY, Iloilo Province, Estancia, Nos. 11654, 23031, 95–97 mm, February 11, 1925; Molo, No. 15468, 85 mm, August 5, 1927: Capiz Province, Capiz, Nos. 12749, 23032, 110 mm, July 30, 1925: Antique Province, Culasi, No. 41123, 89

mm, December 15, 1933. GUIMARAS, Iloilo Province, La Paz, No. 15455, 75 mm, August 6, 1927; Dumangas, Nos. 15451, 23562, 65 mm, August 5, 1927; West coast of Guimaras, No. 41321, 72 mm, December 18, 1934. BALABAC, Palawan Province, Balabac, Nos. 5059-5064, 172-174, August 5, 1908. MIN-DANAO, Davao Province, Davao, 3232, 3486, 125-184 mm, April 25, 1908: Agusan Province, Agusan River, No. 4236, 154 mm, 1904.

In the collection are the following extra-Philippine specimens:

BORNEO, Sandakan, Nos. 2450, 2511, 2541, 2562-65, 2617, 2675, 71-104 mm, February, 1908; No. 14160, 106 mm, November 21, 1925.

ENGRAULIDÆ

Body oblong, elongate, more or less compressed, scales thin, deciduous; belly cultrate or slightly rounded with keeled abdominal scutes; snout prominent, mouth large, bordered by very small intermaxillaries which do not meet in symphysis, and by the long narrow maxillaries which may be prolonged. Teeth in jaws in one row, small, rarely caninoid; teeth present on vomer, palatines, pterygoid and tongue. Dorsal somewhat short, above or in front of anal; anal usually long. Gill membranes more or less united, free from isthmus; 7 to 19 branchiostegals, gill rakers long, slender; pseudobranchiæ present.

This family is usually divided into two subfamilies; namely, the Coiliinæ, in which the body is greatly elongate and the long anal fin unites with the caudal; and the Stolephorinæ, in which the body is not greatly elongate and the anal fin is shorter and not united with the greatly forked caudal. All Philippine members of the family belong to the latter. We have for comparison, however, a number of examples of the genus *Coilia* obtained from China.

Key to the Philippine genera of the Engraulidæ.

- α^1 . Maxillary greatly prolonged, extending to base of pectoral or beyond.
Thrissocles.
- α^2 . Maxillary moderate, not extending to base of pectorals.
 - b^1 . Body well or moderately compressed, without silvery, lateral stripe.
 - c^1 . Ventral scutes strong, developed from gill opening to vent; anal rays about 40..... *Scutengraulis*.
 - c^2 . Ventral scutes weak, almost hidden by the scales, only one or two in front of pectorals; anal rays 32..... *Thrissina*.
 - b^2 . Body more or less subcylindrical, translucent, with a silvery lateral stripe; ventral margin with two to seven sharp scutes only between pectorals and ventrals; anal rays 15 to 37..... *Stolephorus*.

Genus **THRISSOCLES** Jordan and Evermann

Body shape and compression similar to *Scutengraulis*; maxillary excessively long, extending beyond base of pectorals, sometimes even up to anal; gill rakers 10 to 18; pectorals reach to ventrals; origin of anal below last rays of dorsal; no silvery lateral stripe.

One Philippine species.

THRISSOCLES SETIROSTRIS (Broussonet). Plate 1, fig. 6.

Clupea setirostris BROUSSONET, Ichth. 1 (1782).

Clupea mystacina FORSTER, Schneider Syst. Ichth., Bloch (1801) 482; LICHTENSTEIN, Forster Descript. anim. (1844) 295.

Engraulis setirostris CUVIER and VALENCIENNES, Hist. Nat. Poiss. 21 (1849) 69; GÜNTHER, Cat. Brit. Mus. 7 (1868) 397; BLEEKER, Atl. Ichth. 6 (1866-72) 134; DAY, Fishes of India 4°. (1878-1888) 626.

Thryssa macrognathus BLEEKER, Bijd. Ichth. Madura, Verh. Bat. Gen. 12 (1849) 14.

Stolephorus setirostris GÜNTHER, Cat. Brit. Mus. 7 (1868) 397.

Anchovia setirostris JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 237.

Engraulis setirostris GÜNTHER, Fische der Südsee 3 (1909-1910) 379; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 258; Mem. B. P. Bishop Mus. 10 (1928) 32.

Thrissocles setirostris FOWLER, Hongkong Nat. 2 (1931) 202; HERRE, Fish. Herre 1931 Philip. Exp. (1934) 15.

Head 3.7-3.9; depth 3.2-3.5; dorsal I, 10-13; anal 34-36; scales 39-42 in median lateral series; 10-11 in transverse series; 20-22 predorsals; abdominal scutes 27-28, 18 being postventral.

Body elongate, strongly compressed, dorsal and ventral profiles about equal, belly cultrate. Head blunt, snout prominent, short, much less than eye which is 3.5 to 3.7 in head. Maxillary produced to a long filament surpassing ventrals, often reaching anal, strongly expanded near mandibular joint. Jaws with a single row of minute teeth; maxillary prolonged, extending beyond ventrals, often to anal, toothed throughout its entire inferior margin. Dorsal surface of head laterally convex with a prominent median keel; interorbital slightly less than eye. Ventrals conspicuously wanting. Gill rakers 12, finely lanceolate, flattened, inner side spinulose, slightly longer than gill filaments, nearly equal eye. Scales deciduous, with 9 to 12 vertical striae, some discontinuous with median terminals overreaching each other; margins smooth, nonfenestrate.

Dorsal origin slightly nearer caudal base than snout tip; base short, 2 in its height which is slightly longer than head without

snout. Anal long, 3 to 3.3, about twice height. Pectorals about height of dorsal, reaching past ventral insertion. Ventrals more than twice eye, midway between pectorals and anal; reaches to anal opening.

Black venules on shoulder; pale reddish spots superior and inferior to ventral and pectoral bases.

The above description is based on No. 977, 69 mm, obtained in a Manila market, July, 1907.

LUZON, Cagayan Province, Aparri, No. 10384, 117 mm, May 22, 1923; Rizal Province, Malabon, No. 10423, 117 mm, April 21, 1923; Manila, Nos. 63, 207, 208, 977, 110-111 mm, June 12, 1907. MINDORO, Mindoro Province, Calapan, No. 10357, 98 mm, January, 1923; Mangarin, Nos. 11552, 23875-78, 90 mm, 1913.

In the collection are the two following foreign specimens: No. 10345, 115 mm, from Amoy, China, 1923, and No. 10105, 70 mm, from Hoihao, Hainan, 1923, both collected by S. F. Light.

In addition, the following specimens of *Thrissocles dussumieri* (Bleeker) are in the collection: No. 6398, 82 mm, from Hongkong, August, 1910; Nos. 6248, 6253, 6261-62, all about 98 mm long, from Hongkong, 1910. In this species the maxillary does not extend beyond the ventrals.

Genus SCUTENGRAULIS Jordan and Seale

Body thin, deep, compressed, elongate. Scales more or less deciduous. Strong abdominal scutes always present between pectorals and anal, also in front of pectorals. Mouth oblique; maxillary usually produced, ending between mandibular joint and axil of pectoral, usually extending beyond gill-opening. Origin of dorsal ahead of that of anal which is usually rather long (27 to 50 rays). A tiny free spine in front of dorsal. Upper pectoral rays not produced. Teeth present on jaws, vomers palatines, pterygoid, and tongue. No caninoid teeth.

This genus is represented by two species in the Philippines. In addition several specimens of *Scutengraulis hammersleyi*, Nos. 10369, 23890-96, all about 88 mm long, from Amoy, China, are in the collection.

Key to the Philippine species of *Scutengraulis*.

- α^1 . Maxillary reaches only to gill opening..... *S. hamiltonii* (Gray).
 α^2 . Maxillary nearly reaches root of pectoral..... *S. mystax* (Bloch).

SCUTENGRAULIS HAMILTONII (Gray). Dumpilas. Plate 1, fig. 10.

Thryssa hamiltonii GRAY, Illustr. Indian Zool. 2 (1830-35) Pisc. tab. 5, fig. 3 (fig. only).

Engraulis grayi BLEEKER, Verh. Bat. Gen. 24 (1852) 41; KNER, Fische Novara Exp. (1865-67) 333.

Engraulis hamiltonii GÜNTHER, Cat. Brit. Mus. 7 (1868) 395; DAY, Fishes of India 4°. (1878-1888) 625; VINCIGUERRA, Ann. Mus. Civ. Genova 2 (1885) 94; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 258.

Stolephorus hamiltonii BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 261.

Engraulis poorawah BLEEKER, Atl. Ichth. 6 (1866-72) 132.

Trichosoma hamiltonii RUTTER, Proc. Acad. Nat. Sci. Phila. (1897) 66.

Anchovia hamiltonii JORDAN and RICHARDSON, Bull. Bur. Fish. 27 (1907) 236.

Engraulis grayi WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 37.

Scutengraulis hamiltonii JORDAN and SEALE, Bull. Mus. Comp. Zool. Harvard 67 (1926) 371.

Anchoviella hamiltonii DERANIYAGALA, Ceylon Journ. Sci. § C 5 (1933) 81.

Head 4.4; depth 3-3.4; dorsal I, 14; anal 40; scales 38-39 in median lateral series; 11-12 in transverse series, 15 predorsals; abdominal scutes, 16 preventrals, 10 postventrals, sharp and spiny, especially the postventrals.

Body oblong, deep, well compressed; ventral profile slightly more convex than dorsal. Snout shorter than eye, which is 4.3 in head. Maxillary produced, reaching gill opening; dilated at mandibular joint, from thence tapering posteriorly to a sharp point. Jaws about equal with a single row of minute sharp teeth. Dorsal part of head with a sharp median keel, convex, finely tuberculate; interorbital equal eye. Gill rakers 14, strongly flattened, with prominent spines on inner edge; about 1.4 longer than filaments, slightly less than orbit. Scales large, rather deciduous, with 7 to 15 transverse striæ, broken, irregularly arranged, those near posterior border anastomosing and reticulate; posterior margin irregularly serrate.

Dorsal origin nearer caudal than snout tip; base short, about 2 in its height which is about equal to head without snout. Anal long, 3.1 in body length, height 2.7 in its base. Pectoral nearly as long as height of dorsal, reaches to ventral origin, first ray large, strong. Ventral small, about 1.5 times eye, 2.7 in pectoral, nearer pectoral than anal, far in advance of dorsal origin.

With black venules on scapular region.

This description is based on No. 41286, 197 mm, collected by Mr. A. F. Umali from Divisoria market, March 13, 1931.

LUZON, Camarines Sur Province, Calanga, Nos. 13244, 23853-23863, 120-125 mm, January 16, 1926. LEYTE, Leyte Province, Tacloban, No. 1200, 170 mm, September 4, 1907.

In addition, we have 5 specimens, No. 10126, 113 mm, from Haichow, Hainan, China.

SCUTENGRAULIS MYSTAX (Bloch). Plate 1, fig. 8.

Clupea mystax BLOCH, Schneider Syst. Ichth. (1801) 426.

Thryssa porava BLEEKER, Verh. Bat. Gen. 22 (1849) 14.

Engraulis mystacoides BLEEKER, Verh. Bat. Gen. 24 (1852) 42; GÜNTHER, Cat. Brit. Mus. 7 (1868) 396.

Engraulis hamiltonii KNER, Fische Novara Exp. (1865-67) 334.

Engraulis mystax BLEEKER, Atl. Ichth. 6 (1868-72) 132; DAY, Fishes of India 4^o. (1878-1888) 625; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 38; CHAUDHURI, Mem. Indian Mus. 5 (1916) 424.

Trichosoma porava RUTTER, Proc. Acad. Nat. Sci. Phila. (1897) 65.

Scutengraulis mystax JORDAN and SEALE, Bull. Mus. Comp. Zool. 67 (1926) 370.

Head 4.3-4.7; depth 3.3-3.5; dorsal I, 14; anal 40-42; scales 40-44 in median lateral series; 11-12 in transverse series; pre-ventral scutes 17-19 (5 or 6 of which are prepectorals); post-ventrals 9-11.

Body oblong, well compressed, dorsal profile nearly straight; ventral profile well convexed. Mouth large; maxillary much elongate, tapering to a point, and nearly reaching base of pectorals. Snout short, slightly longer than half diameter of eye which is 4 in head; a single row of small teeth on each jaw. Teeth on pterygoid, vomer, palatine, and tongue. Upper surface of head with a median longitudinal crest which extends from snout to nape; tuberculate and with small melanophores along sides of crest. Interorbital equal to eye. Branchiostegals 11 to 13; gill rakers 13, compressed, rather firm, distinctly spinous. Scales large, adherent, with 4 to 8 transverse striae, 2 to 4 continuous; hind margin serrated with narrow and regular crenulations.

Dorsal slightly nearer caudal than snout; base 1.6 in height which is more than twice body depth. Anal long, 2.7 to 3, inserted below posterior ray of dorsal; height twice caudal peduncle. Pectorals slightly longer than head without snout. Ventrals small, 2.5 in pectorals, greater than orbit; inserted

well in front of dorsal; much nearer pectorals than anal; pectorals extending past ventral origin.

Scapular region with melanophores in clusters arranged in rows; dark spots along dorsal margin from head to caudal.

The above description is based on Nos. 23951 and 23954, 100 mm and 112 mm, obtained from Cabusao, Camarines Sur.

LUZON, Camarines Sur Province, Cabusao, Nos. 11454, 23951-54, 78-100 mm, December 21, 1918; San Miguel Bay, Nos. 115687, 23976-82, 71-113 mm, September 27, 1924; No. 12039, 119 mm, February-March, 1922. SAMAR, Samar Province, Basse, No. 14721, 152 mm, December 6, 1926. PANAY, Iloilo Province, Barotoc, No. 15448, 90 mm, August 4, 1927. NEGROS, Negros Occidental Province, Cadiz, No. 16190, 132 mm, August, 1929.

One specimen, No. 14175, 78 mm, was collected from Sandakan, Borneo, November 21, 1925.

Genus *THRISSINA* Jordan and Seale

Scutes small, almost hidden by the scales, usually absent in front of pectorals. Body moderately compressed not very deep. Maxillary not extending posterior of root of mandible. Gill rakers about 23.

THRISSINA BÆLAMA (Forskål). Dampilas. Plate 1, fig. 7.

Clupea baelama FORSKÅL, Descript. anim. (1775) 72; BLOCH, Schneider, Syst. Ichth. (1801) 429.

Engraulis baelama CUVIER and VALENCIENNES, Hist. Nat. Poiss. 21 (1848) 26; GÜNTHER, Cat. Brit. Mus. 7 (1868) 393; BLEEKER, Atl. Ichth. 6 (1866-72) 130; KLUNZINGER, Verh. z. b. Ges. Wien 21 (1871) 597; GÜNTHER, Proc. Zool. Soc. London (1871) 671; DAY, Fishes of India 4°. (1878-1888) 626; GÜNTHER, Fische der Sudsee 3 (1909-1910) 379.

Stolephorus encrasicholoides BLEEKER, Ned. Tijdschr. Dierk. 1 (1863) 236.

Engraulis encrasicholoides KNER, Fische Novara Exp. (1865-1867) 333; GÜNTHER, Cat. Brit. Mus. 7 (1868) 387; SCHMELTZ, Cat. Mus. Godeffroy (1869) 25; MACLEAY, Proc. Linn. Soc. N. S. W. 7 (1882) 593; 8 (1883) 278.

Anchovia baelama JORDAN and RICHARDSON, Bull. Bur. Fish. 27 (1907) 236; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 239.

Engraulis baelama WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 33; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 258; Mem. B. P. Bishop. Mus. 10 (1928) 32.

Thrissina baelama JORDAN and SEALE, Bull. Mus. Comp. Zool. 67 (1926) 376; HERRE, Fish. Herre 1931 Philip. Exp. (1934) 15.

Head 3.5–3.7; depth 4–4.4; dorsal II, 13; anal 27–30; scales 34–36 in lateral median series; 9 in transverse series; 14 predorsals; 17 abdominal scutes, 8 preventrals.

Body only compressed, not very deep, dorsal and ventral profiles nearly equal in convexity, scutes pointed behind, weakly attached, none in front of pectorals except a single reduced one, just behind isthmus. Length of caudal peduncle about equal to its least depth, less than 3 in head. Snout large, length less than an orbit, about 4.5 in head. Mouth large, oblique; maxillary long but not extending beyond root of mandible; equals head minus snout, longer than ventrals, thick and narrow anteriorly, rather broad and flat posteriorly. Lower jaw short, small, extensible below ventral margin. Both jaws with a row of firm, minute, closely-set teeth. Teeth on vomer, tongue, pterygoid, and palatine. Eye well advanced, 3 times nearer snout than opercular opening. Interorbital convex, keeled on median longitudinal plane, striated and tuberculate. Posterior opercular edge oblique, dorsal portion well advanced. Cheeks veined, tuberculate. Branchiostegal rays 13 to 15. Gill rakers 19 to 23, lanceolate, compressed, spinulous on exposed edge, longer than filaments, slightly less than orbit. Pseudobranchiæ 20 to 22, short, unequal, base hidden in membranous flap. Scales rather adherent, large with 12 to 15 transverse striations. Posterior margin irregularly serrate, produced portion often with several small reticula.

Dorsal nearer snout than caudal base, well in front of anal; base about 1.8 in its longest ray. Ventrals 2.2 in head, longer than caudal base, slightly nearer pectorals than anal. Pectorals longer than ventrals, just reaching insertion of latter. Anal long, about equal body depth, twice length of peduncle; height slightly less than ventrals.

This description is based on Nos. 23931 and 23943, 90 and 95 mm.

LUZON, Cagayan Province, Buguey, Barrio Mission, No. 12884, 68 mm, December 9, 1905: Ilocos Norte Province, Bangui, Barrio Caunayan, Nos. 14366, 23920–23, 81–91 mm, August 19, 1926: La Union Province, Luna, No. 14305, 55 mm, August 10, 1926: Manila, Manila market, Nos. 524, 977, 83–69 mm, July, 1907; Nos. 6798, 6805, 62–65 mm, June, 1910: Rizal Province, Pasay, No. 12464, 70 mm, October 17, 1905: Batangas Province, Batangas, No. 2225, 67 mm, June 16, 1908: Albay Province, Legaspi, Legaspi market, Nos. 13330, 23930–50, 81–100 mm, February 2, 1926. LEYTE, Leyte Province, Cabalian, Nos. 10829,

23792-95, 79-91 mm, May 24, 1922. PANAY, Iloilo Province, Estancia, Nos. 23914-17, 86 mm, July, 1922. NEGROS, Oriental Negros Province, Polo Plantation, No. 15444, 92 mm, August 21, 1927. BANTAYAN, Cebu Province, Bantayan, Nos. 5961, 5966, 5969, 54-70 mm, May, 1909. MINDANAO, Misamis Province, Cagayan, No. 1452, 78 mm, September 8, 1907; No. 1557, 84 mm, September 12, 1907: Surigao Province, Surigao, No. 10902, 92 mm, June 5, 1922: Zamboanga Province, Zamboanga, Nos. 2897, 2899, 21472, 23809-10, 58-88 mm, April 10, 1908; No. 2978, 53 mm, April 13, 1908; No. 4195, 49 mm, May 28, 1908; Nos. 23802-03, 51-69 mm, June, 1908: Davao Province, Davao, Nos. 3325, 3329, 23800-01, 23806-08, 42-88 mm, April 24, 1908; No. 3468, 94 mm, April 26, 1908; No. 4540, 65 mm, April 21, 1908. SAMAL, Davao Province, Samal, Nos. 3574, 23804-05, 32-73 mm, April 29, 1908.

Genus *STOLEPHORUS* Lacépède

Body elongate. Scales thin, deciduous; not more than 7 prominent spiny scutes between pectorals and ventrals. Snout prominent; maxillary may be produced up to gill opening. Dorsal without small predorsal spine, placed totally or partly in front of anal. Anal short with 16 to 23 rays. Upper pectoral ray not produced. Teeth present on jaws, vomer, palatines, pterygoids, and tongue. Branchiostegals 11 to 13; caudal peduncle at least twice as long as high at its end. A silvery band present along the sides.

This genus is represented by four species in the Philippines, one of which is not present in the collection.

Key to the Philippine species of *Stolephorus*.

a¹. Origin of anal behind dorsal; anal about 6 in length.

S. heterolobus Rüppell.

a². Origin of anal below dorsal.

b¹. Five to seven spiny abdominal scutes present between pectorals and ventrals; maxillary produced to gill opening; anal 5.4 to 5.8 in length *S. commersonii* (Lacépède).

b². Four to five abdominal scutes between pectorals and ventrals.

c¹. Maxillary reaching to front border of preoperculum; anal 6 to 6.2 in length *S. indicus* (van Hasselt).

c². Maxillary reaching gill opening; anal 5 to 5.4 in length.

S. tri (Bleeker).

STOLEPHORUS COMMERSONII Lacépède. Dillis; bolinao. Plate 2, fig. 6.

Stolephorus commersonii LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 382; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 45; CHAUDHURI, Mem. Indian Mus. 5 (1916) 426.

- Engraulis Brownii* CUVIER and VALENCIENNES, Hist. Nat. Poiss. 21 (1848) 29 (ex parte); KNER, Fische Novarra Exp. (1865-1867) 332.
Engraulis commersonianus GÜNTHER, Cat. Brit. Mus. 7 (1868); DAY, Fishes of India 4°. (1878-1888) 629.
Stolephorus commersonianus BLEEKER, Atl. Ichth. 6 (1866-72) 128.
Anchovia commersoniana JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 5.
Anchovia commersonii FOWLER, Copeia No. 58 (June, 1918) 62.
Engraulis commersonii FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 258.

Head 3.7-4; depth 4.8-5.2; dorsal 14-15; anal 19-20; scales 37-40 in median lateral series, 8 in transverse series; 15-18 predorsals; 5-7 abdominal scutes, with sharp spines, between ventrals and pectorals.

Body elongate, slightly compressed; dorsal and ventral profiles equally convex. Mouth large, maxillary extending almost to gill opening, broad behind and with large teeth inserted at wide intervals among minute teeth. Snout less than eye diameter which is 3.6 in head. Tubercles on cheek, postorbital, preopercle, and top of head. Interorbital about an eye. Gill rakers 20 to 21, spiny on inner edge, slightly flattened, rather slender, about twice gill filaments, slightly less than eye. Scales very deciduous, large, with a variable number of transverse and longitudinal striæ which are often anastomosing and reticulate; margins smooth.

Dorsal slightly nearer snout tip than caudal base; base less than height, about 2 in head. Anal short, 5.4 to 5.8, inserted below last rays of dorsal. Pectorals less than maxillary, about 1.7 in head. Ventrals longer than orbit, slightly nearer pectorals than anal, ahead of dorsal origin.

With a prominent silvery lateral band which attains greatest width posteriorly. Top of head, nape, upper portion of operculum, lateral band, base of dorsal, and whole caudal fin powdered with minute melanophores.

Described from Nos. 7896, 41182, 41183, and 41184, ranging in size from 37 to 70 mm, collected from Carigara, Leyte Province, March 10, 1913.

LUZON, Manila, Manila market, Nos. 6855-57, 57-58 mm, July, 1915. SAMAR, Samar Province, Catbalogan, No. 12500, 54-62 mm, September 19, 1925. LEYTE, Leyte Province, Carigara, Nos. 7896, 41182-41184 (212 specimens), 37-70 mm, March 10, 1913.

STOLEPHORUS INDICUS (van Hasselt). Tuakang or dilis. Plate 2, fig. 8.

Engraulis indicus VAN HASSELT, Algemeene Konst en Letterbode (1823) 329; DAY, Fishes of India 4°. (1878-1888) 629; STEINDACHNER, Sitz. Akad. Wiss. Wien 115 (1906) 1424; GÜNTHER, Fische der Südsee 3 (1909-1910) 377; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 259.

Engraulis albus SWAINSON, Fishes 2 (1839) 293.

Engraulis balinensis BLEEKER, Verh. Bat. Gen. 22 (1849) 11.

Engraulis brownii CANTOR, Journ. Asiat. Soc. Bengal 18 (1849) 1285 (nec Gaimard); DAY, Fish. Malabar (1865) 237; PLAYFAIR and GÜNTHER, Fish. Zanz. (1866) 123.

Engraulis russelli BLEEKER, Verh. Bat. Gen. 24 (1852) 38; GÜNTHER, Cat. Brit. Mus. 7 (1868) 790.

Engraulis samaninan THIOLLIÈRE, Fauna Woodlark (1857) 208.

Stolephorus indicus BLEEKER, Atl. Ichth. 6 (1866-1872) 127; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 46; CHAUDHURI, Mem. Indian Mus. 5 (1916) 425.

Anchovia indica JORDAN and HERRE, Proc. U. S. Nat. Mus. 31 (1906) 638; JORDAN and SEALE, Bull. U. S. Fish. 26 (1906) 5; EVERMANN and SEALE, Bull. U. S. Fish. 26 (1906) 54.

Engraulis indica FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 33.

Head 3.8-4.2; depth 5.2-5.5; dorsal 16; anal 19-20; scales 37-40 in median lateral series; 8-9 in transverse series; 19-20 predorsals; 4 spiny abdominal scutes between ventrals and pectorals.

Body elongate, slightly compressed; profiles more or less equally convex, with a prominent silvery band along sides, greatest width about snout length. Caudal peduncle long, about head without operculum, 4.5. Snout prominent, slightly more than 2 in eye; maxillary flat, broad, reaching to front border of preopercle. Top of head laterally convex, flat dorsally, crested at median line; interorbital 1.3 in eye which is 3.3 to 3.5 in head. Gill rakers 20 to 22, flattened, spinous on inner edge, with characteristic furrow along center of flat surfaces. Branchiostegals 11. Scales very deciduous, large, with 4 to 9 crenulations arising from basal margin extending to about middle portion and ending posteriorly as groove of regular and distinct serrations of the margin. Basal margin lined by 2 to 4 layers of thick-walled reticula, the marginal ones being produced anteriorly to a point giving margin a comblike aspect.

Dorsal nearer snout than caudal; base greater than height, about twice orbit. Anal short, 6 to 6.2, well advanced, less than caudal peduncle, inserted about last third of dorsal base. Ven-

trials slightly longer than an orbit, inserted about midway from pectorals and anal. Pectoral slightly more than 2 in head; not reaching ventrals. With a characteristic black heart-shaped spot on postfrontal and a brown one on nape.

The above description is based on Nos. 12358, 23915, 23916, and 23929, 87 to 93 mm, collected from San Pedro Bay, near Basey, Samar, September 17, 1925.

LUZON, La Union Province, Damortis, Rosario, Nos. 14289, 23821-23, 64-89 mm, August 4, 1926: Rizal Province, Malabon, No. 753, 107 mm, July 18, 1907; Pasay, Nos. 12464, 23924, 72-73 mm, October 17, 1925: Manila, Manila market, No. 819, 82 mm, June 17, 1907; No. 928, 97 mm, May, 1907; No. 10964, 78 mm, 1922; Nos. 23971-75, 78-80 mm, 1912; Divisoria Market, Nos. 41248-49, 21248-9, 95-100 mm, March 13, 1931: Batangas Province, Balayan, Nos. 41221, 41243, 64-78 mm, December, 1932. MINDORO, Mindoro Province, Calapan, No. 10344, 99 mm, January, 1923; Nos. 23797-99, 96-100 mm, January, 1921. LEYTE, Leyte Province, Carigara, Nos. 14789, 23814, 98-104 mm, December, 1926; Nos. 7937, 7942, 97-99 mm, December 11, 1913. SAMAR, Samar Province, San Pedro Bay, near Basey, Nos. 23926-29, 86-91 mm, September 17, 1925. NEGROS, Negros Oriental Province, Zamboanguita, Nos. 13905, 23918-19, 86-104 mm, February 22, 1926: Occidental Negros Province, Licab, Nos. 21244-47, 107-108 mm, August 29, 1929; Sicaba, Nos. 41244, 41247, 110 mm, August, 1929. GUIMARAS, Iloilo Province, West coast of Guimaras Island, No. 41314, 35-68 mm, (22 young specimens), December 18, 1933.

STOLEPHORUS TRI (Bleeker). Plate 2, fig. 14.

Engraulis tri BLEEKER, Verh. Bat. Gen. 24 (1852) 40; GÜNTHER, Cat. Brit. Mus. 7 (1868) 389; VON MARTENS, Exp. Ostasien, Zool. 1 (1876) 404; DAY, Fishes of India 4°. (1878-1888) 630; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 259.

Stolephorus tri BLEEKER, Atl. Ichth. 6 (1866-72) 128; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 47; CHAUDHURI, Mem. Indian Mus. 5 (1916) 426.

Head 3.7-4; depth 4.5-4.7; dorsal 14; anal 20-22; scales 30-32 in median lateral series along silvery band; 8-9 in transverse series; 19-23 predorsals; 4-6 spiny scutes between pectorals and ventrals.

Body elongate, more compressed than *S. indicus*, but with greater depth; ventral and dorsal profiles subequal. Caudal peduncle long, about 1.7 in head. Mouth large; maxillary flat, broad behind mandibular joint and extending as a blunt point

to edge of operculum. Snout less than eye which is 3 in head. Interorbital about an eye; top of head with sharp median keel. Gill rakers 22, spiny on inner edge, twice length of branchial filaments. Branchiostegals 13. Scales very deciduous, large, with 10 to 15 transverse continuous striæ; margin nonserrated.

Dorsal nearer caudal base than snout tip; base about its height and caudal peduncle. Anal advanced, 5 to 5.4, about equal to head without snout, height equals snout plus eye. Pectoral shorter than maxillary not reaching ventral which is slightly longer than eye diameter. Anal inserted midway between pectoral and anal.

With a characteristic dark brown spot on top of head behind interorbital divided into two halves by the median keel.

The above description is based on No. 23811, 72 mm, from Borongan, Samar, September 3, 1907, and No. 23925, 64 mm, from Carigara, Leyte, December 1, 1926.

LUZON, Manila, Manila market, Nos. 319, 416, 82 mm, June 27, 1907; No. 535, 75 mm, July 10, 1907: Bataan Province, Orani, Nos. 10949, 23958, 23970, 48-88 mm, April 23, 1923: South coast of Luzon, Nos. 375, 380, 382, 58-91 mm, June, 1907. SAMAR, Samar Province, Borongan, Nos. 1170, 23811-12, 62-74 mm, Dec. 3, 1907. GUIMARAS, Iloilo Province, West coast of Guimaras Is., No. 41147, 29-72 mm, (16 young specimens), December 18, 1933.

This species is close to *S. indicus* in having the same number of scutes, and the same characteristic mark on top of head, but it differs in that its maxillary extends to the margin of operculum. It is similar to *S. commersonii* in the extent of the maxillary but is easily distinguished from it in the number of scutes and in body proportions.

CLUPEIDÆ

Body oblong, ventrally compressed with the belly keeled with scutes along edge. Snout never overshot; teeth either small or wanting. Mouth bordered by intermaxillaries but principally by maxillaries which have two supplemental bones. Pseudo-branchiæ present and gill rakers slender. Scales thin, regular or pectinate, perforate or entire, and crenulate or smooth.

Key to the Philippine genera of Clupeidæ.

a¹. Anal fin moderate, with 15 to 25 soft rays; ventrals well developed, jaws equal.

b¹. Origin of dorsal behind that of ventrals; vomerine teeth present.

Clupeoides.

b². Origin of dorsal before that of ventrals; no vomerine teeth.

- c*¹. No teeth in jaws; last two anal rays enlarged; scales with transverse striæ, interrupted..... *Sardinella*.
*c*². Teeth present in jaws; last anal rays not enlarged; scales with mostly continuous transverse striæ..... *Harengula*.
*a*¹. Anal fin with very long base; with more than 25 soft rays; ventrals small or wanting; dorsal fin present; lower jaw prominent.... *Ilisha*.

Genus CLUPEOIDES Bleeker

Body oblong, compressed, with ventral profile much more convex than dorsal. Scales thin but firm, ventral scutes prominent. Origin of ventrals ahead of or on same level as that of dorsal. Anal fin single. Teeth present on jaws, palatines, pterygoids, and vomer.

One Philippine species is known.

CLUPEOIDES LILE (Cuvier and Valenciennes). Silag. Plate 2, fig. 7.

Meletta lile CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 378.

Alausa champil CANTOR, Journ. Asiat. Soc. Bengal (1850) 1284 (nec Gray).

Rogenia argyrotaenia BLEEKER, Verh. Bat. Gen. 24 (1852) 26; BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 457; KNER, Fische Novara Exp. (1865-67) 328.

Clupea argyrotaenia GÜNTHER, Cat. Brit. Mus. 7 (1868) 423.

Clupea (Clupeoides) argyrotaenia BLEEKER, Atl. Ichth. 6 (1872) 101.

Clupea lile DAY, Fishes of India 4^o. (1878-88) 638.

Harengula chrysotaenia JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 187.

Clupeoides lile WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 57; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 31; CHAUDHURI, Mem. Indian Mus. 5 (1916) 426.

Head 4.2-4.5; depth 2.8-3.2; dorsal 16; anal 17; scales 36-38 in median lateral series; 9 in transverse series; 15-17 predorsals; 28 abdominal scutes, 17 being preentrals.

Body strongly compressed, abdomen extremely cultrate, sharp, bordered by prominent and firm scutes. Ventral profile greatly convex; dorsal profile slightly convex, keeled from nape to dorsal origin. Length of caudal peduncle slightly less than its least depth, 2.3 in head. Snout less than eye which is 2.6 to 2.8 in head. Gill rakers 37 to 40, finely lanceolate, smooth, about as long as filaments, about radius of eye. Pseudobranchiæ 12 to 15. Scales rather adherent, depth greater than length, with 1 to 3 continuous transverse striations; posterior margin weakly serrate.

Dorsal nearer snout than caudal, height about as long as base. Anal low, base about 1.7 times caudal peduncle, slightly

less than dorsal base and about 2 in body depth. Pectorals rather long, equal head measured from snout tip. Ventrals slightly more than 2 in head, about 1.6 in pectorals midway between snout tip and caudal peduncle and between pectorals and anal; anal opening depressed between last abdominal scute and anal fin.

Dorsal margin, post frontal, tip of snout, caudal fin, and base of caudal with dark spots.

The above description is based on three specimens.

LUZON, Camarines Sur Province, Barrio Sibubu, Nos. 13136, 2313, 54-67 mm, January 13, 1926. PANAY, Iloilo Province, Molo, No. 15467, 74 mm, August 5, 1927.

Genus SARDINELLA Valenciennes

Body compressed; belly keeled, with scutes; no distinct median notch in upper jaw, teeth feeble on palatines and tongue; opercle without radiating striæ; pseudobranchiæ present; branchiostegals 6; scales large, firm, with interrupted striæ; anal long, last two rays enlarged; ventral opposite dorsal.

Key to the Philippine species of *Sardinella*.

- a¹. Belly obtuse, not sharp-edged; postventral scutes small and flatly carinated.
 - b¹. Maxillary reaches up to level of front edge of eye; 14 or 15 postventral abdominal scutes.
 - c¹. A longitudinal band present, often with a series of dark spots; 30 gill rakers *S. leiogaster* (Cuvier).
 - c². No lateral band; 40 gill rakers..... *S. sirm* (Rüppell).
 - b². Maxillary distinctly distant from level of front edge of eye; 12 postventral abdominal scutes; no lateral band; 28 gill rakers.
 - S. clupeioides* (Bleeker).
- a². Belly compressed, with sharp edge; medium scutes.
 - b¹. Scales in median lateral series less than 40.
 - S. jussieu* (Lacépède).
 - b². Scales in median lateral series 40 or more.
 - c¹. Depth 3 to 4 in standard length.
 - d¹. Scales in median lateral series about 40.
 - S. melamura* (Cuvier and Valenciennes).
 - d². Scales in median lateral series more than 50.
 - e¹. Scales regular, entire, not perforate; gill rakers smooth, 95 to 110 *S. samarensis* sp. nov.
 - e². Scales pectinate, fenestrate.
 - f¹. Depth 3.8 to 4 in length.
 - S. fimbriata* (Cuvier and Valenciennes).
 - f². Depth 3 to 3.2 in length..... *S. perforata* (Cantor).
 - c². Depth 4 or more.

*d*¹. Scales in transverse series 12 to 13; eye 4 to 4.5; depth about 4; teeth on palatines, pterygoid, and tongue; anal 13 to 16; gill rakers more than 140.

S. longiceps (Cuvier and Valenciennes).

*d*². Scales in transverse series 9 or 10; eye 3.5; depth 4.5 to 5; teeth on tongue only; anal 20; gill rakers 32.

S. schrammi (Bleeker).

Of the above, *S. leiogaster*, *S. chupeoides*, and *S. schrammi* are not represented in the collection.

SARDINELLA SIRM (Rüppell). Plate 2, fig. 4.

Clupea sirm RÜPPELL, Neue Wirbelthiere (1835-1840) 77; GÜNTHER, Cat. Brit. 7 (1868) 425; GÜNTHER, Fische der Südsee 3 (1909-1910) 383.

Sardinella leiogastroides BLEEKER, Nat. Tijdschr. Ned. Ind. 7 (1854) 255.

Clupea (Amblygaster) leiogastroides BLEEKER, Atl. Ichth. 6 (1872) 102.

Sardinella sirm JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 1905 (1906) 186; FOWLER, Mem. B. P. Bishop Mus. 10 (1928).

Clupea (Amblygaster) sirm WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 62.

Head 4-4.2; depth 4.6-4.8; dorsal 18; anal 18; scales 44-45 in median lateral series; 10-11 in transverse series; 13-14 predorsals; 16 preventral, and 15 postventral scutes.

Body moderately compressed; dorsal profile more convex than ventral. Least depth of caudal peduncle equal to its length. Head width 2 in its length. Snout width about 1.7 in its length which is 3.2 in head. Eye advanced, 3.5 to 3.7 in head. Maxillary barely reaches front margin of eye, about 2.5 in head. Teeth on palatine, tongue, and pterygoid. Interorbital venulose, its width equal to orbit. Distinct striation on preopercle, suborbital, and postfrontal. Gill rakers 40 to 41, stout, lanceolate, fairly rigid, spinulated on compressed sides, smooth on edges; length more than a radius of orbit, 1.6 in branchial filaments; 20 pseudobranchiæ. Scales deciduous, large, entire; posterior margin uniformly serrated, indistinctly crenulate; 3 to 6 transverse striæ which are usually all interrupted at middle, scale close to that of *S. longiceps* but differs from this in having uniform weak serration on margin, in having usually no continuous transverse striæ, and in being relatively larger.

Dorsal origin nearer snout tip than caudal base; base longer than height, 2.2 to 2.4 in head. Caudal deeply forked, lobes shorter than head, covered with small alar scales. Pectorals 1.5 in head, longer than height of dorsal, first ray stout, hard.

Ventral insertion below middle of dorsal, nearer pectoral than anal, 1.7 in pectoral, less than dorsal base. Anal base 2.5 times its height, about height of dorsal.

The above description is based on No. 13277, Legaspi, Albay Province, Luzon, February 2, 1926, and Nos. 21388-89, Sulade Island, Sulu Province, November 7, 1927, 173-191 mm.

LUZON, Batangas Province, Nasugbu, Barrio Papaya, No. 13265, 175 mm, January 13, 1926; Albay Province, Legaspi market, Nos. 21469-77, 13277, 15127, 58-173 mm, September 21, 1924. POLILLO, Tayabas Province, Polillo, No. 12597, 180 mm, September 25, 1925. MINDORO, Mindoro Province, Calapan, Nos. 11423, 21411-12, 129-130 mm, January 6, 1923; Bulalacao Bay, No. 14626, 160 mm, December 20, 1926; Pinamalayan, Nos. 6821, 21490. BANTAYAN, Cebu Province, Bantayan, Nos. 5957, 5970, 5989, 50-124 mm, May, 1909. NEGROS, Negros Oriental Province, Dumaguete, Nos. 15016, 21435, 171-172 mm, March 15, 1927. CAMIGUIN, Misamis Province, Catarman, Nos. 15020, 21440, 165-169 mm, February 10, 1927. MINDANAO, Misamis Province, Cagayan, No. 1451, 69 mm, September 8, 1907; Nos. 1745, 1759-60, 21310, 57-80 mm, September 15-17, 1907; No. 21308, 34 mm, September 13, 1908, Gingoog, Barrio Odiongan, No. 21423, 93 mm, February, 1927: Agusan Province, Butuan Bay, Nos. 1903, 1905, 84-97 mm, September 25, 1907: Davao Province, Davao, No. 3095, 80 mm, April 20, 1908; Nos. 3311, 3320, 92-118 mm, April 23, 1908; Nos. 3398, 3406, 60-67 mm, April 25, 1908: Zamboanga Province, Zamboanga, No. 4478, 65 mm, June 16, 1908; Nos. 21309-21313, 34-64 mm, 13, 1908. SAMAL, Davao Province, Samal, Nos. 3629-3631, 159-166 mm, May 1, 1908. JOLO, Sulu Province, Jolo, Nos. 2395, 2402, **2405**, 2423, 24 to 150 mm, February, 1908. BUNGAU, Sulu Province, No. 13860, 178 mm, April 15, 1926. SULADE, Sulu Province, Nos. 15734, 21388-89, 21436, 171-191 mm, November 7, 1927.

SARDINELLA JUSSIEU (Lacépède). Plate 2, fig. 2.

Clupanodon jussieu LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 469-471.

Clupea jussieu GÜNTHER, Cat. Brit. Mus. 7 (1868) 430.

Clupea otaitensis (Solander) CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 257.

Spratella fimbriata SCHMELTZ, Cat. Mus. Godeffroy 4 (1869) 25.

Clupea tembang GÜNTHER, Cat. Brit. Mus. 7 (1868) 426; SCHMELTZ, Cat. Mus. Godeffroy 5 (1874) 36; GÜNTHER, Report Voyage "Challenger" 1 (1880) 36.

Clupea gibbosa GÜNTHER, Fische der Sudsee 3 (1909-1910) 381.

Harengula sundaica KENDALL and GOLDSBOROUGH, Mem. Mus. Comp. Zool. 26 (1911) 243.

Clupea exile KISHINOUE, Journ. Coll. of Agr. Tokyo 2 (1911) 384.
Sardinella jussieu FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 257; Mem. B. P. Bishop Mus. 10 (1928) 30.

Head 4-4.2; depth 3.5-3.7; dorsal 16-17; anal 17; scales 37-39 in median lateral series; 10-11 in transverse series; predorsals 13-14; 16-17 preventral scutes, 12-13 postventrals.

Body spindle-shaped, compressed; belly cultrate with sharp rather prominent scutes; dorsal profile less convex than ventral. Caudal peduncle deep, least depth 1.2 times length which is 2.6 in head. Head very close to *S. fimbriata*; width 2.2 to 2.3 in its length. Snout width slightly narrower than its length which equals eye. Maxillary 2.3 in head, barely reaching below front margin of pupil. Interorbital equal to eye, slightly convex; postocular part of head with distinct striæ. Extensive venules on cheek, preopercle, and dorsal half of operculum. Gill rakers 45 to 49, lanceolate, broad, smooth, about as long as gill filaments. Scales large, adherent, nonfenestrate; posterior margin irregularly serrate, with 4 to 6 transverse striæ, one continuous.

Dorsal origin 1.3 times nearer snout tip than caudal base; base shorter than height, 1.7 in head, slightly more than 2 in body depth. Anal low, 1.3 in head, longer than dorsal base. Pectorals slightly shorter than anal, equal head minus snout. Ventrals 1.4 times longer than orbit, midway between pectorals and anal, below first quarter of dorsal.

This species is closest to *Harengula dispilonotus* in scale and gill raker count and to *Sardinella fimbriata* in the shape of the head. It differs, however, from the former in having the transverse striæ in the scales broken and in having a protruding snout. It differs from *S. fimbriata* in the scale and gill raker count and in the structure of the scales.

LUZON, Ilocos Sur Province, Santa Maria, Nos. 11200, 21494, 21495, 93-96 mm, January 23, 1923.

SARDINELLA MELANURA (Cuvier and Valenciennes). Plate 2, fig. 13.

Alausa melanura CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 324.

Harengula (Paralosa) valenciennessi BLEEKER, Verh. Akad. Amsterdam (2) (1868) 300 (nomen solum).

Clupea melanura GÜNTHER, Cat. Brit. Mus. 7 (1868) 449; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 239.

Clupea (Harengula) melanurus Bleeker, Atl. Ichth. 6 (1872) 111.

Clupea (Alausa) melanura VON MARTENS, Exp. Ostasien, Zool. 1 (1876) 405.

Harengula melanura SAUVAGE, Poiss. Madagas. (1891) 492.

Harengula vanicoris JORDAN and SEALE, Bull. U. S. Bur. Fish. 25 (1906) 187.

Clupea (Harengula) melanura WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 72.

Sardinella melanura FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 257.

Head 3.8; depth 3.5–3.7; dorsal 15–17; anal 18–21; scales 38–40 in median lateral series; 10–11 in transverse series, 16–17 preventral scutes; 11 postventrals.

Body compressed, abdomen cultrate, with sharp, prominent scutes; ventral profile slightly more convex than dorsal; snout slightly concave. Caudal peduncle deep, greater than length which is 1.5 times eye diameter. Snout equals eye, about 3.3 in head; maxillary reaches to below front margin of pupil, slightly more than 2 in head. Striations on cheek, postorbital, and postfrontal. Interorbital about an eye, slightly convex, gill rakers 40 to 42, lanceolate, flattened, thickly-set, smooth. Scales moderate, rather adherent, entire, with 2 to 4 vertical striae, 1 complete; hind border irregularly serrate; very similar to that of *S. longiceps*.

Dorsal origin nearer snout tip than caudal base, midway between snout tip and last ray of anal; length less than height which is 1.8 in head. Anal rather long, 1.6 in head. Pectorals equal head minus snout, greater than twice body depth. Ventrals 1.5 times eye, midway between pectorals and anal, below middle of dorsal.

BATAN, Batanes Province, No. 627, 70 mm, July, 1907. LEYTE, Leyte Province, Carigara, Nos. 7828–30, 37–47 mm, November 10, 1923.

SARDINELLA SAMARENSIS sp. nov. Tamban Irayan. Plate 2, fig. 11.

Head 3.8–4; depth 3.5–3.7; dorsal 18; anal 15; scales 43–45 in median lateral series; 9–11 in transverse series; 16–18 predorsals; 16–18 preventral scutes, 14–15 postventrals.

Body fusiform, compressed; dorsal profile slightly more convex than ventral; belly cultrate; scutes not very prominent. Snout width 1.4 in its length which is slightly greater than eye; tip produced to form with vertex a prominent concavity. Head width 2.4 in its length; eye 4, 1.8 nearer snout tip than hind margin of operculum. Maxillary 2.4 in head, reaches to below middle of eye. Interorbital rather concave, slightly less than orbit, equals greatest width of operculum. Postocular part of head deeply veined; venules on cheeks. Gill rakers 96 to 102, finely lanceolate, flattened, smooth, short, about half gill filaments which are 0.7 to 0.8 in eye. Scales adherent, subcircular,

nonfenestrate, with 2 to 5 transverse striæ, one usually complete; hind margin irregularly pectinate.

Dorsal 1.4 times nearer snout tip than caudal base; base depressed, equals height, about 2 in head. Anal low, 1.2 longer than dorsal, 1.7 in head, 1.6 times length of caudal peduncle. Pectorals equal anal base. Ventrals 1.5 times orbit, equidistant from pectorals and anal, inserted below middle of dorsal. Although in body shape this species is similar to *H. moluccensis* and *S. fimbriata*, its other characters are very distinct.

Samarensis, for Samar, the province and island from which the type was obtained.

Type.—No. 41217, 114 mm, collected by Mr. A. F. Umali from Barrio Cinco, Catbalogan, Samar Province, Samar Island, March 8, 1932. Two other specimens, Nos. 41218 and 41219, 104 mm, from the same place and of the same date, are also in the collection.

SARDINELLA FIMBRIATA (Cuvier and Valenciennes). Tunsoy or laolao. Plate 2, fig. 5.

Spratella fimbriata CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 263; BLEEKER, Verh. Bat. Gen. 24 (1852) 27; KNER, Fische Novara Exp. (1865-67) 329.

Clupea gibbosa BLEEKER, Journ. Ind. Arch. 3 (1849) 72; GÜNTHER, Fische der Südsee 3 (1909) 381.

Spratella tembang BLEEKER, Verh. Bat. Gen. 24 (1852) 28; KNER, Fische Novara Exp. (1865-1867) 329.

Clupea tembang GÜNTHER, Cat. Brit. Mus. 7 (1868) 426.

Clupea fimbriata GÜNTHER, Cat. Brit. Mus. 7 (1868) 427; DAY, Fishes of India 4^o. (1878-1888) 637.

Clupea (Harengula) fimbriata BLEEKER, Atl. Ichth. 6 (1872) 105; WEBER and DE BEAUFORT, Verh. Akad. Amsterdam 17 No. 3 (1912) 10; Fish. Indo-Austr. Arch. 2 (1913) 75.

Clupea (Harengula) sundaica BLEEKER, Atl. Ichth. 6 (1872) 105.

Clupea (Harengula) gibbosa BLEEKER, Atl. Ichth. 6 (1872) 106.

Clupea sundaica MACLEAY, Proc. Linn. Soc. N. S. W. 4 (1879) 373; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 236.

Harengula gibbosa JORDAN and SEALE, Bull. Bur. Fish. 26 (1906) 4; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236.

Harengula sundaica JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236.

Sardinella fimbriata FOWLER, Copeia (June, 1918) 62; Proc. Acad. Nat. Sci. Phila. 79 (1927) 257.

Clupea (Harengus) fimbriata DERANIYAGALA, Spolia Zeylanica 15 (1929) 41.

Head 4.3; depth 3.5-3.6; dorsal 17-18; anal 18; scales 46-48 in median lateral series; 12-13 in transverse series; 17-18 predorsals; abdominal scutes, 17 preventrals, 15-16 postventrals.

Body well compressed, dorsal profile slightly convex; ventral profile sharp, more convex than upper. Caudal peduncle 2.5

in head, compressed, least depth equals its length. Head width twice its length. Snout width about 1.3 its length which is 3.5 to 3.6 in head. Eye advanced, 3.5 in head. Maxillary reaches to below anterior third of eye. Teeth absent on jaws. Interorbital flat, 4.5 in head; venules on vertex. Gill rakers 65 to 73, finely lanceolate, about 0.7 in eye, about 1.3 times gill filaments. Pseudobranchiæ 17. Scales largely adherent, often irregular; crenulate, fenestrate, distinctly pectinate; 4 or 5 vertical striæ, 1 complete.

Base of dorsal embedded in scaly sheath; origin much nearer snout tip than caudal base; longest ray 1.3 in head. Pectorals about twice ventrals. Ventral below middle of dorsal, nearer pectorals than anal, 2.5 to 2.7 in head. Anal low, depressible among scaly flaps, 1.8 in head.

The structure of the scales of this species is close to that of the scales of *S. perforata*, but the latter has a distinctly deeper body.

This description is based on No. 41167, 111 mm, obtained from Tondo, Manila, Luzon, October 18, 1930.

LUZON, Bulacan Province, Malolos, No. 15386, 111 mm, April 9, 1927; No. 21252, 94 mm, April 19, 1927: Rizal Province, Malabon, No. 649, 103 mm, July 18, 1907: Manila, Manila market, No. 88, 102 mm, May 31, 1907; No. 106, 112 mm, June 1, 1907; Nos. 211-212, 99-104 mm, June 12, 1907; Manila, No. 3, 83 mm, May 20, 1907; Nos. 6869-71, 6873, 6890, 48-123 mm, June, 1910; Nos. 11535, 21265-68, 47-66 mm, April 14, 1913; Paco Market, No. 11387, 114 mm, September 19, 1919; Tondo, Nos. 41168-73, 94-107 mm, October 18, 1930: Cavite Province, Cavite, No. 127, 68 mm, May, 1907. MINDORO, Mindoro Province, Calapan, Nos. 21246-47, 14204, 21249-50, 75-100 mm, January, 1923. PANAY, Iloilo Province, Estancia, Nos. 16177, 21253-57, 75-104 mm, August 12, 1927; Nos. 21235-39, 94-101 mm, July 19, 1927; Nos. 21431-33, 92-98 mm, July, 1922.

SARDINELLA PERFORATA (Cantor). Lapad or halubaybay. Plate 2, fig. 10.

Clupeonia perforata CANTOR, Journ. Asiat. Soc. Bengal 18 (1850) 1276.

Spratella kowala BLEEKER, Nat. Tijdschr. Ned. Ind. 2 (1851) 492.

Harengula (Spratella) kowala BLEEKER, Versl. Akad. Ams. 2 (1863) 294.

Clupea perforata GÜNTHER, Cat. Brit. Mus. 7 (1868) 424.

Clupea (Harengula) perforata BLEEKER, Atl. Ichth. 6 (1872) 110;

WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 74.

Sardinella perforata EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 54; FOWLER, Proc. Acad. Nat. Sci. Phila. 53 (1911) 206.

Head 3.6; depth 3.2; dorsal 18; anal 22; scales 41-46 in median lateral series; 11-13 in transverse series; predorsals 17-18; abdominal scutes, 16-18 preventrals, 12 postventrals, sharp, prominent.

Body spindle-shaped, compressed as in *S. fimbriata*, but deeper; dorsal and ventral profiles smoothly convex, more than that of *S. fimbriata*. Vertex flat, straight. Caudal peduncle deep; least depth 1.3 times its length, about 2.5 in head. Head width 2 in its length. Snout suppressed, width nearly equal length which is 3.7 in head. Eye advanced, about 3 in head. Maxillary 2.3 to 2.5 in head, extends beyond anterior margin of orbit. Interorbital slightly convex, 3.7 in head; vertex veined. Gill rakers 66, fine, lanceolate, 1.8 in orbit; gill filaments 1.2 to 1.3 in gill rakers. Pseudobranchiæ equal, 18. Scales crenulate, pectinate, distinctly fenestrate, with large, rounded holes; 4 to 5 transverse striæ, 1 complete.

Base of dorsal embedded in scaly sheath; origin nearer snout than caudal base; height 1.4 in head. Pectorals 1.2 head, twice ventrals. Ventral origin slightly in advance of middle of dorsal, nearer pectorals than anal, 2 in head. Anal low, its two last rays extensive; base 1.6 in head.

This species differs from *S. fimbriata* in having a deeper body, a greater and more prominent curvature of the ventral profile, and in having characteristic scales.

The above description is based on No. 6874, 101 mm, Manila Bay, Manila, Luzon, June, 1910.

LUZON, Manila, Manila market, Nos. 210, 275, 365, 83-90 mm, June 12-14, 1907; Nos. 11551, 21242-45, 72-102 mm, December 18, 1924; Manila, Nos. 6872, 6875-89, 56-103 mm, June, 1910; Rizal Province, Pasay, Nos. 12177, 21522-27, 72-85 mm, October 17, 1925; Cavite Province, Cavite, Nos. 118-19, 153, 80-83 mm, May 21, 1907; Salinas, Nos. 41174-78, 100 mm, October 1, 1930; Camarines Sur Province, Cabusao, Nos. 11917, 21509-14, 67-93 mm, December 21, 1918; Sorsogon Province, Bacon, Nos. 3660-61, 94-102 mm, 1904. PANAY, Iloilo Province, Estancia, Nos. 16181, 21239, 97-93 mm, July 19, 1927.

SARDINELLA LONGICEPS Cuvier and Valenciennes. Tamban; tamban lison; tuloy.
Plate 2, fig. 1.

Sardinella longiceps CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 198; FOWLER, Proc. Acad. Nat. Sci. Phila. 79 (1927) 257.

Sardinella neohowii CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 198.

Alosa scombrina CUVIER and VALENCIENNES, Hist. Nat. Poiss. 20 (1847) 324.

- Sardinella lemuru* BLEEKER, Nat. Tijdschr. Ned. Ind. 4 (1853) 500.
Clupea lemuru GÜNTHER, Cat. Brit. Mus. 7 (1868) 430.
Clupea scombrina GÜNTHER, Cat. Brit. Mus. 7 (1868) 448.
Clupea (Harengula) lemuru BLEEKER, Atl. Ichth. 6 (1872) 108.
Clupea longiceps DAY, Fishes of India 4^o. (1878-1888) 637.
Clupea (Harengula) longiceps WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 82.
Clupea (Harengus) longiceps DERANIYAGALA, Spolia Zeylonica 15 (1929) 44.

Head 3.25-3.5; depth 4; dorsal 17; anal 13-15; scales 44-47 in median lateral series; 13-14 in transverse series; 13-16 predorsals; ventral scutes, 14-17 preventrals, 14-17 postventrals.

Body slightly compressed, fusiform. Least depth of caudal peduncle nearly equals its length, 3.5 in head. Head width 2.2 to 2.3 in its length; snout width 1.3 to 1.5 its length which is 3.5 in head measured from tip of upper jaw. Eye 4 to 4.2. Maxillary 2.3 in head, nearly reaches below middle of eye. Interorbital flat, about 5 in head. Cheek with prominent striæ on preopercle and operculum. Gill rakers 142 to 171, smooth, finely lanceolate, about 1.2 in eye, about twice gill filaments. Scales largely adherent, crenulate, entire, with 4 to 5 vertical striæ, 1 complete.

Dorsal and anal depressible in basal scaly flaps; dorsal origin nearer snout than caudal base; dorsal 2.2 to 2.3 in head. Pectorals about twice ventrals, 1.7 in head. Ventrals inserted below middle of dorsal origin, nearer anal than pectorals, 3.3 in head. Anal low, its base 2.5 in head, last ray well developed.

This species has a much longer and thicker body than most other species of the genus. It also grows much larger.

The above description is based on Nos. 41163 and 41164, 89-103 mm, Estancia, Iloilo Province, Panay, July, 1927.

LUZON, Ilocos Sur Province, Santa Maria, Nos. 11200, 21494-96, 94-101 mm, January 23, 1923: Manila, Manila market, No. 18, 140 mm, January 16, 1908: Batangas Province, Nasugbu, Barrio Papaya, No. 13265, 155 mm, January 13, 1926. POLILLO, Tayabas Province, Polillo, No. 12597, 181 mm, September 25, 1925. MINDORO, Mindoro Province, Pinamalayan, No. 6821, 158 mm, January, 1913; Calapan, No. 11423, 129 mm, January 16, 1923; Bulacao Bay, No. 14626, 161 mm, December 20, 1926. LEYTE, Leyte Province, Cabalian, Nos. 9644 and 21414, 113 mm, June 1, 1921; Carigara, Nos. 7897-99, 69-75 mm, December 11, 1913. PANAY, Iloilo Province, Estancia, Nos. 11261, 21346-78, 128-146 mm, September, 1924; Nos. 12161, 12193, 21398-99, 21400, 21491-93, 119-146 mm, July 17, 1925;

Nos. 16183, 21269-77, 89-103 mm, June 21, 1927. NEGROS, Negros Oriental Province, Dumaguete, No. 21436, 167 mm, March 15, 1927. CAMIGUIN, Misamis Province, Catarman, No. 21440, 168 mm, February 10, 1927. MINDANAO, Zamboanga Province, Zamboanga, Nos. 4115, 4123, 4128, 4140, 90-100 mm, May 22, 1908; No. 4420, 107 mm, June 12, 1908; No. 2868, 93 mm, April 9, 1908; Dipolog, Nos. 15019, 21504-07, 108-119 mm, March 14, 1927.

Genus HARENGULA Valenciennes

Body oblong or partly oblong; abdominal scutes with distinct spine or smooth; edge of upper jaw without median notch; vomerine teeth always absent; scales firmly adnate, thin, with transverse striæ continuous or overlapping; dorsal with low scaly basal sheath; hind anal rays equal, not enlarged.

Key to the Philippine species of *Harengula*.

*a*¹. Scales in median lateral series less than 40.

H. dispilonotus (Bleeker).

*a*². Scales in median lateral series more than 40.

*b*¹. Gill rakers less than 50.... *H. moluccensis* (Cuvier and Valenciennes).

*b*². Gill rakers about 60, spinous..... *H. tawilis* Herre.

HARENGULA DISPILONOTUS Bleeker. Plate 2, fig. 12.

Harengula dispilonotus BLEEKER, Nat. Tijdschr. Ned. Ind. 3 (1852) 456.

Clupea dispilonotus GÜNTHER, Cat. Brit. Mus. 7 (1868) 429; MAX WEBER, Fische Siboga Expeditie 65 (1913) 9.

Clupea (Harengula) dispilonotus BLEEKER, Atl. Ichth. 6 (1872) 112.

Harengula dispilonotus FOWLER, Proc. Acad. Nat. Sci. Phila. 85 (1933) 246.

Harengula dispilonotus HERRE, Fish. Herre 1931 Philip. Exp. (1934) 15.

Head 3.6-3.7; depth 3-3.2; dorsal 17-18; anal 19-20; scales 32-34 in median lateral series; 10 in transverse series; 15 pre-ventral scutes; 12-13 postventrals.

Body oblong, well compressed, with trenchant abdomen lined by sharp, prominent scutes; ventral profile slightly more concave than dorsal. Caudal peduncle short, about half its least depth, less than eye diameter. Snout slightly less than eye, about 3.2 in head measured from tip of upper jaw. Maxillary reaches to below front margin of pupil. Interorbital equal, orbit flat, forming with protruding snout tip a concavity on head profile. Gill rakers 42 to 45, finely lanceolate, slightly compressed, spinous; longer than filaments, slightly longer than radius of orbit. Scales rather deciduous, round, with 3 to 6 vertical striæ.

tions, all complete; similar to scales of *H. moluccensis*; margins rarely serrate. Dorsal origin 1.3 nearer snout than caudal base. Length nearly equals height, equals head without snout. Anal low, twice length of caudal peduncle, 1.6 in head. Pectorals equal base of dorsal. Ventrals 1.4 times orbit, slightly nearer anal than pectorals, below middle of dorsal.

With two characteristic dark brown spots, one at about last third of dorsal and another about an orbit posterior to the former.

MINDORO, Mindoro Province, Mangarin, No. 10976, 90 mm, 1913. PANAY, Iloilo Province, Iloilo, Nos. 14242, 21395-21397, 112 mm, July 2, 1922. BALABAC, Palawan Province, Balabac, Nos. 5014-5041, 21218, 21219, 51-54 mm, August 3, 1908.

HARENGULA MOLUCCENSIS Bleeker. Plate 2, fig. 3.

Harengula moluccensis BLEEKER, Nat. Tijdschr. Ned. Ind. 4 (1853) 609; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 4; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 53; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236; SEALE and BEAN, Proc. U. S. Nat. Mus. 33 (1907) 239.

Harengula kunzei BLEEKER, Nat. Tijdschr. Ned. Ind. 12 (1856-1857) 209.

Clupea moluccensis GÜNTHER, Cat. Brit. Mus. 7 (1868) 427.

Clupea (Harengula) moluccensis BLEEKER, Atl. Ichth. 6 (1872) 107; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 81.

Clupea (Harengula) kunzei BLEEKER, Atl. Ichth. 6 (1866-1872) 107.

Clupea kunzei DAY, Fishes of India 4^o. (1878-1888) 636; GÜNTHER, Fische der Südsee 8 (1909) 382.

Clupea (Harengus) moluccensis DERANIYAGALA, Spolia Zeylanica 15 (1929) 43.

Head 3.8; depth 3.6; dorsal 18-19; anal 17; scales 42-45 in median lateral series; 12-13 in transverse series; 12-13 predorsals; abdominal scutes, 17 preentrals, 12-13 not prominent postentrals.

Body compression and depth intermediate between *S. fimbriata* and *S. perforata*; fusiform; dorsal profile more convex than ventral. Ventral edge not sharp, as in *S. fimbriata*, less trenchant than that of *S. perforata*. Caudal peduncle shorter than deep, least depth 1.7 times length, about 2.6 in head. Head width twice length, thicker than any portion of body. Snout width greater than length, forming with eye and preorbital a deep concavity; width 3.7 in head. Eye advanced, about 3 in head. Maxillary 2.1 in head, reaches to below first third of eye. Interorbital slightly concave, depressed towards tip; vertex with few venations. Cheek extensively veined. Gill rakers 36 to 41,

length about 2 in orbit, equal to gill filaments. Pseudobranchiæ equal, 14 to 15. Scales strongly adherent, crenulate, entire, irregularly serrate; 4 to 6 transverse striæ, all, or almost all, complete.

Dorsal origin nearer snout tip than caudal base; longest ray about 1.7 in head. Pectoral 1.7 in head, 1.6 times ventrals. Ventrals inserted slightly in front middle of dorsal, equidistant from pectorals and anal; 1.8 in head. Anal depressible in scaly flaps, low, last two rays well developed; anal base 1.7 in head, equals dorsal base.

The above description is based on Nos. 2358 and 2429, 98 and 106 mm, obtained from Jolo Island, Sulu Province, February, 1908.

LUZON, Ilocos Norte Province, Bangui, Nos. 14340, 21515-19, 85 mm, August 19, 1926: Zambales Province, Olongapo, Nos. 150-151, 88 mm, May, 1907: Batangas Province, Balayan Bay, No. 2339, 90 mm, January 20, 1908: Cavite Province, Cavite, No. 128, 103 mm, May, 1907. PANAY, Iloilo Province, Estancia, No. 21434, 62 mm, July, 1922. CEBU, Cebu Province, Cebu, No. 1258, 28 mm, September 5, 1907. PALAWAN, Palawan Province, Puerto Princesa, Nos. 5487-88, 60-63 mm, August 4, 1908; Nos. 213311-12, 57 mm, August 21, 1908: BALABAC, Palawan Province, No. 21298, 57-72 mm, August 10, 1908. CAMIGUIN, Misamis Province, Camiguin, No. 608, 89 mm, June, 1907. MINDANAO, Misamis Province, Cagayan, No. 1521, 48 mm, September 9, 1907; No. 1543, 84 mm, September 12, 1907: Surigao Province, Surigao, No. 1772, 57 mm, September 17, 1907. BUNGAU, Sulu Province, Bungau, Nos. 11382, 21497-99, 87-91 mm, August 27, 1924. SIBUTU, Sulu Province, Sibutu, Nos. 13731, 21401-05, 98-108 mm, May 3, 1926.

HARENGULA TAWILIS Herre. *Tawilis*. Plate 2, fig. 15.

Harengula tawilis HERRE, Philip. Journ. Sci. 34 (1927) 273, pl. 3, figs. 1-6.

Head 4.2-4.5; depth 3.2-3.6; dorsal 18-19; anal 20-21; scales 40-42 in median series; 11-12 in transverse series; 11-13 predorsals; 16-18 preentrals, 11 postentrals.

Body compression, dorsal profile, and convexity similar to those of *S. perforata*; ventral profile slightly more convex, but as trenchant; body deeper. Caudal peduncle compressed, least depth 1.4 times its length. Snout width 1.2 in its length which is 3.5 in head, measured from tip of snout. Eye advanced, 3.4 in head. Maxillary reaches below third of eye, 2.3 in head.

Interorbital slightly convex, veined. Gill rakers 58 to 60, spinulose, lanceolate, 1.8 in orbit, 1.2 in gill filaments. Pseudobranchiæ 16, equal. Scales very adherent, regular, entire. Transverse striæ 4 to 6, most commonly 5, 1 to 3 continuous, the rest discontinuous, the central terminals running past each other.

Dorsal fin depressible in a sheath of scales; origin nearer snout tip than caudal base; longest ray 1.4 to 1.5 in head. Pectorals 1.6 times ventral which is 2.2 in head. Ventral origin below middle of dorsal, nearer to pectorals than to anal. Anal low, base about twice length of caudal peduncle, 1.6 in head, isometric with dorsal base.

Scales closest to those of *H. moluccensis* but differ in being less elliptical; in having several discontinuous, though overreaching, transverse striæ; in being crenulate; and in being more, though irregularly, pectinate.

The above description is based on Nos. 21316, 21317, and 21325, 85–114 mm, Lake Bombon (Taal), Batangas Province, November 8, 1925.

LUZON, Batangas Province, Bombon Lake (Taal) Nos. 15157, 23947, 26983, 89–110 mm, April, 1927; Nos. 21383, 21387, 10801, 85–90–92 mm, February 17, 1921; Nos. 13198, 21318–45, 21327, 21345, 85–115 mm, March 1, 1926; Nos. 14237, 21314–26, 97–114 mm, November 8, 1925.

Genus ILISHA (Gray) Richardson

Body oblong, much compressed. Scales thin, deciduous. Lower jaw prominent, mouth cleft oblique. Upper pectoral ray strong and broad, anal very long with 35 to 54 rays, its origin below or just behind dorsal; ventrals small, its origin in advance of dorsal. Gill rakers stout, few (about 20) spinulous all around.

One Philippine species is known.

ILISHA HOEVENII Bleeker. Tuabak. Plate 2, fig. 9.

Pellona hoevenii BLEEKER, Verh. Bat. Gen. 24 (1852) 21; DAY, Fishes of India 4°. (1878–1888) 644.

Pellona hoevenii GÜNTHER, Cat. Brit. Mus. 7 (1868) 455.

Ilisha hoevenii BLEEKER, Atl. Ichth. 6 (1872) 117; JORDAN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 5; EVERMANN and SEALE, Bull. U. S. Bur. Fish. 26 (1906) 54; JORDAN and RICHARDSON, Bull. U. S. Bur. Fish. 27 (1907) 236; FOWLER, Copeia No. 58 (June, 1918) 62; Proc. Acad. Nat. Sci. Phila. 79 (1927) 258.

Head 3.3–3.4; depth 2.7–2.9; dorsal 18; anal 36; scales 42–44 in median lateral series; 11–12 in transverse series, 10 predorsals; 27 prominent abdominal scutes, 18 being preentrals.

Body strongly compressed, deep; ventral profile more convex than dorsal; ventral edge cultrate with sharp, firm, serrature. Caudal peduncle well compressed, deep, 1.6 to 1.8 in its least depth which is 2.8 in head measured from tip of lower jaw. Head width 2 in its length. Snout width greater than length, about 3 in head. Eye advanced, 2.5 to 2.7 in head, 2.6 times snout length; maxillary extends to pupil of eye, about 1.3 times eye diameter, twice head length; distal margin of accessory bone and maxillary finely denticulated throughout; snout, with orbit, preorbital, postorbital, and interorbitals, forms a deep concavity. Teeth on intermaxillary small, but larger than those of accessory maxillary. Teeth present also in lower jaw, tongue, palatine, and pterygoid. Interorbital somewhat concave, with a prominent pair of furrowed ridges which meet posteriorly about an orbit past occiput; vertex not conspicuously veined. Suborbital veined. Gill rakers 20 to 23, coarsely lanceolate, spiny on upper margin, firm; 1.3 to 1.5 in gill filaments, about 5 in orbit. Pseudobranchiæ 20 to 22, all equal. Scales very deciduous, large, commonly subcordate, smooth, entire, unimbricated portion usually produced to an obtuse point; 4 to 6 transverse striæ, one complete, others interrupted at midportion.

Dorsal origin raised on summit of a sharp, firm keel, midway between tip of upper jaw and caudal base; behind ventrals; base length isometric with longest ray, 1.6 in head from maxillary tip, 2.3 in body depth. Caudal deeply forked. Pectorals 2.2 times ventrals, greater than dorsal base, 1.5 in head, 1.8 times its axillary scale. Ventral insertion midway between pectoral and anal origin, small; length less than an orbit. Anal low, elongate, longer than head, twice dorsal base; origin slightly behind last dorsal ray. Anal opening deeply indented behind last abdominal scute.

This species differs from all other forms of *Ilisha* in having a supplemental bone instead of a ligament between the lateral end of intermaxillary and upper end of maxillary.

The above description is based on Nos. 7810-12, 118-134 mm, Carigara, Leyte Province, Leyte Island, November 11, 1913.

LUZON, Manila, Manila market, No. 364, 96 mm, January 20, 1907; Manila, No. 6810, 108 mm, June, 1910; Divisoria market, No. 41180-81, 116-125 mm, November 15, 1930. MINDORO, Mindoro Province, Calapan, No. 21251, 60 mm, 1923. MASBATE, Masbate Province, Masbate, No. 14244, 119 mm, June 2, 1925. LEYTE, Leyte Province, Carigara, Nos. 7803, 7814-15, 7812-18, 7820, 7850, 7855, 118-134 mm, November 11, 1913. PANAY,

Antique Province, Culasi, Nos. 41112, 41179, 80-94 mm, December 15, 1933. GUIMARAS, Iloilo Province, west coast of Guimaras Island, Nos. 41311, 41325 (82 specimens), 41328 (93 specimens), 41331 (86 specimens), 27-33 mm, December 18, 1933.

STERNOPTYCHIDÆ¹

Body short, anterior portion elevated, compressed or elongated, with "carinated contour." Eyes large, sometimes telescopic. Without barbels. Gape of mouth vertical or nearly so with upper margin constituted by the supramaxillaries and intermaxillaries. Dorsal may be preceded by spines, located about middle of body. Adipose fin low, totally or partly above hind part of anal which may be divided. Ventrals small, below or before origin of dorsal. Scales present or absent; if present, large, thin, and very deciduous. Preorbital, postorbital, and ocular luminous organs single; those on body in groups. No whitish punctiform organs on fins. Branchiostegals 5 to 11; arch near to and parallel with lower jaw. Gill rakers well developed. Pseudobranchiæ present or absent.

"Deep sea fishes, rising toward the surface at night or in stormy weather." (Jordan and Evermann, 1896).

Key to the Philippine genera of Sternoptychidæ.

- α^1 . Body much elevated, compressed, short, height about 1.5. Anal short, 11 to 17 rays. Pseudobranchiæ present. Eyes normal.
- b^1 . Dorsal fin preceded by a forked spine, without anterior dilation. No abrupt ventral constriction between trunk and tail. Covered with large, thin, and deciduous scales. Teeth on vomer. Branchiostegals 9 to 11, short..... *Polyipnus* Günther.
- b^2 . Dorsal fin preceded by a large transparent triangular plate. With an abrupt ventral constriction between trunk and tail which is filled by a transparent integumentary plate resembling thin cartilage. No teeth on vomer. Branchiostegals 5.

Sternoptyx Hermann.

- α^2 . Body elongate, not elevated, scaleless, height about 3.7 to 3.8. Anal long, 23 to 24 rays. Dorsal short, not preceded by a strong spine or hyaline plate. Caudal emarginate. Eyes normal, pseudobranchiæ wanting *Valenciennellus* Jordan and Evermann.

The record of Philippine deep-sea fishes is very incomplete. Aside from the little work done by the "Challenger" in 1873-76, no collection of the deep-sea fishes has been made in and around the Philippines.

¹ After Günther (1887), Jordan and Evermann (1896) and Weber and de Beaufort (1913).

Genus POLYIPNUS Günther

Body elevated, strongly compressed, ventral portion between trunk and tail without abrupt constriction; covered with large, very thin, and deciduous scales. Dorsal fin without anterior spinous dilation but preceded by a forked spine. Anal not divided, short, with 15 to 17 rays. Adipose fin low. Eyes normal, large. Teeth on vomer. Branchiostegals short, 9 to 11. Gill rakers rather long.

One Philippine species is known.

POLYIPNUS SPINOSUS Günther.

Polyipnus spinosus GÜNTHER, Rep. Voyage "Challenger," Deep-Sea Fishes (1887) 170; ALCOCK, Ann. & Mag. Nat. Hist. (VI) 4 (1889) 137-398; BRAUER, Deutsche Tiefsee Exp. Tiefseefische (1906) 120; MAX WEBER, Fische Siboga Expeditie 65 (1913) 22; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 130-131.

Head 3; depth 1.3-1.8; dorsal 12-13; anal 15-17; pectoral 12-14; ventral 5.

Head much higher than long, 2.5. Vertical diameter of eye 0.5 or somewhat more of length of head. Snout very short, less than pupil. Dorsal part of head with 2 serrated ridges, each beginning behind nostril and bordering a concave space, then converging towards middle of occiput and continuing as strong, diverging crests, ending in a sharp recumbent spine. Edge of preoperculum armed with a slender, clawlike spine, pointing vertically downward and serrated near its angle. Gape of mouth vertical, bordered above by slender intermaxillary and maxillary. Hinder half of latter broad, rounded behind the gape. Mandibles received within the upper jaw, their lower border denticulated. A band of minute, curved teeth on intermaxillary and mandibles, and a single series on maxilla; similar teeth on vomer. Symphysis and its inferior posterior angle with a blunt spine.

Ventral edge of body serrated, with an anterior and posterior spine, followed by a spinulous edge on each side between ventrals and anal. Origin of dorsal near middle of body, preceded by a small bifid spine. Origin of anal on posterior third of body. Low adipose fin midway between dorsal and caudal. Pectorals low in position, reaching almost as far as base of small ventrals. Anus immediately before anal. Caudal forked. Extremely thin, large, deciduous scales. Luminous organs: an oval black spot on preorbital before middle of eye, a postorbital one on the same level, a suborbital below middle of eye; a small

opercular below level of suborbital; 6 between branchiostegal rays; a series of 6 between isthmus and base of pectorals; a series of 10 along ventral edge, between humeral and pelvic symphysis; 5 between ventrals and anal; a series of 6 to 12 above and behind anal and a series of 4.5 behind there decreasing in size posteriorly, the last above the first caudal ray; 2 above and 3 behind base of pectorals; 2 on side of trunk below middle line. Silvery, back yellowish brown. Length 85 mm.

The type species of the genus *Polyipnus* Günther (1887) is *P. spinosus*. The type specimen was obtained by the "Challenger" at Station 200, between the Philippine Islands and Borneo, at a depth of 250 fathoms.

This species is not represented in the collection. The above description is based on that of Günther (1887).

Genus STERNOPTYX Hermann

Trunk much elevated and compressed, slender tail very short; with an abrupt ventral constriction between trunk and tail which is filled by a transparent integumentary plate. Greater portion of body scaleless and covered with a silvery pigment. Dorsal fin preceded by a large triangular transparent plate. Anal short, 11 to 17 rays, undivided, incompletely developed. Adipose fin represented by a very low membranous fringe of the dorsal margin of tail. Teeth on jaws in several series, the largest teeth in a single row. No teeth on vomer. Eyes large, normal, lateral. Pseudobranchiæ present. Gill rakers moderate. Branchiostegals 5.

One Philippine species is known.

STERNOPTYX DIAPHANA Hermann.

Sternoptyx diaphana HERMANN, Der Naturforscher 16 (1781) 8; GME-LIN, Syst. Nat. Linnæus (1789) 1150; GÜNTHER, Cat. Brit. Mus. 5 (1864) 387; GOODE and BEAN, Bull. Mus. Comp. Zool. 10 No. 5 (1833) 220; GÜNTHER, Rep. Voyage "Challenger" Deep-Sea Fishes (1887) 168; GILBERT and CRAMER, Proc. U. S. Nat. Mus. 19 (1897); BRAUER, Deutsche Tiefsee Exp., Tiefseefische (1906) 115; GILBERT, Bull. U. S. Fish. Comm. 23 pt. 2 (1903) 609; ZUGMAYER, Camp. Scient. Monaco 35 (1911) 54; MAX WEBER, Fische Siboga Expeditie 65 (1913) 22; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 132; FOWLER, Mem. B. P. Bishop Mus. 10 (1928) 35.

Sternoptyx hermanni LACÉPÈDE, Hist. Nat. Poiss. 5 (1803) 613.

Dorsal 12; anal 14; head 2.6–2.8 measured along axis connecting tip of snout and lateral center of caudal peduncle; depth 1.4–1.7, taken at right angle to snout-caudal axis. Body deep, strongly compressed; belly pushed considerably downward and

forward beneath head, pectoral portion being protracted to below snout. Ventral portion of trunk abruptly narrow almost perpendicularly to a short, small, and much more compressed tail. Narrow ventral margin reaches to same level with eye, and tail region extends above level of head. Lower part between trunk and tail occupied by a transparent integumentary portion whose entire ventral margin bears the transparent anal fin. Ventral profile much more convex than dorsal and its contour disturbed by marginal spines borne on protuberances which they intensify to acuteness. A strong, hyaline, unpaired spine at angle formed by the oblique isthmus and the straight ventral margin of trunk. Two bifid closely set spines on pelvic symphysis on posterior portion of ventral margin of trunk. Anterior spine long, directed forward; posterior one short, directed posteriorly. Head short but deep, triangular, with opercular margin at longest side, and occiput as point of acute angle, the whole triangle slightly tipped backward on its upper portion. Cleft of mouth subvertical, more or less concave, with tip of snout looming forward. Snout extremely short, bordered by much reduced intermaxillary and maxillary. Lower jaw received in upper jaw; dentine translucent; postero-inferior angle with a short spine. Unequal minute teeth on margins of both jaws. Eye large, orbital socket oval, with greatest diameter on dorsoventral axis; located above and slightly advanced from symphysis of jaws; equal oral cleft. Interorbital narrow, slightly wider than the pupil. Vertex from snout tip to occiput, about equal straight ventral margin of trunk, steep, more or less straight, made concave by 2 prominent, serrate, hyaline, ridges which arise from snout tip passing low on upper margin of orbit and meeting at occipital region. Operculum proportionately drawn out dorsoventrally; soft, membranous; opercular opening correspondingly wide. Posterior limb of preopercle bordering hind part of orbit, and descending obliquely. Trunk semihyaline, its ventral side straight and keeled by a sharp, transparent lamina. Pectorals well developed, carried down to below eye with drawn thorax, barely reaching ventrals. Ventrals small, arising behind bifid spines, and received in a shallow, concave recess. A long, sharp, hyaline spine behind recess where trunk climbs to a perpendicular. Anal long, rays rudimentary, in the form of a transparent plate supported by externally visible interhæmal rays. Dorsal origin immediately or slightly behind superior pelvic symphysis, with a

prominent spine strengthened in front by a sharp triangular lamella. Lamella less finely serrate than verticle ridges, originating immediately behind rhomboid flat area which marks the occiput. Lamella has a spine which is directed backward. Adipose fin represented by a low hyaline keel which runs continuous with dorsal margin of caudal. Caudal hyaline, broad, forked; peduncle oblique, running about 45° with level of trunk. Scales absent. Gill rakers 14, tuberculate, widely spaced, about length of gill filaments.

General body color dirty brown.

LUMINOUS ORGANS

A series of luminous spots runs along the lower edge of the abdomen, and is separated from that of the other side by a cartilaginous fold occupying the median line of the abdomen; another series runs on each side of the isthmus; a row of three above and behind the root of the ventrals, and another row of three above the vent. The luminous organs on the lower part of the tail consist anteriorly of a row of four, of which the first is prolonged towards the back as a narrow band, terminating about the middle of the depth of the body in a globular spot with a white centre; posteriorly in front of the caudal rays there is another row of four small spots A luminous organ occupies the inner side of the operculum close to its lower end; another is placed at the anterior end of the ceratohyal, and, finally, a very large glandular mass is lodged on the upper edge of the anterior end of the clavicle (Günther, 1887.)

The above description is based on one specimen, No. 15983, 27 mm, collected by the Danish Scientific Expedition, June 16, 1929, at its Station No. 3731, XIV, $119^{\circ} 52' E.$ Long. $14^{\circ} 37' N.$ Lat. about 60 miles NWW off Lubang Island, Mindoro, at a depth of 1,000 meters.

Genus VALENCIENNELLUS Jordan and Evermann

Body elongate, not elevated, strongly compressed, scaleless. Head strongly compressed; mouth wide, subvertical, maxillary broad, curved. Teeth on jaws. Luminous organs on head; a ventral series between isthmus and ventrals and between ventrals and anal, the organs touching each other; between origin of anal and caudal five groups of organs on rather large black patches. Dorsal short, not preceded by strong spine. Adipose fin low, distinct, immediately behind dorsal. Caudal emarginate. Anal long, undivided, with 23 to 24 rays. Eyes normal, large, lateral. Pseudobranchiæ wanting.

One Philippine species is known.

VALENCIENNELUS TRIPUNCTULATUS (Esmark).

Maurolicus tripunctulatus ESMARK, Vidensk. Selskaps Forhandl. Christiana (1870) 488; LÜTKE, Spolia Atlantica, Scopelini (1892) 269.

Valenciennellus tripunctulatus JORDAN and EVERMANN, Fishes of North and Middle America 1 (1896) 278; MAX WEBER, Fische Siboga Expedition 65 (1913) 20; WEBER and DE BEAUFORT, Fish. Indo-Austr. Arch. 2 (1913) 136.

Head 3.3–3.7; depth 3.7–3.8; dorsal 7; anal 24; pectoral 10; ventral 7.

Body elongate, tapering posteriorly. Eye 2.5, about equal snout. Gape of mouth very oblique, nearly vertical. Both jaws with minute teeth. No teeth on vomer. Origin of dorsal opposite first rays of anal, in the middle of the length. Pectorals about 0.7 to 0.8 of head, reach to ventrals which are short. Scales wanting.

LUMINOUS ORGANS

Luminous organs: 16–17 organs, touching each other, in a ventral series between isthmus and ventrals. A lateral series of 10, four of which before pectorals, the fifth above the pectorals, 2 somewhat smaller ones, close together, behind the pectorals and followed at a short distance by the larger 3 equally distant, hindmost. Between ventrals and anal a series of 5, touching each other. These and the lateral series of organs consists of round organs, partly silvery, partly blackish, bordered by a metallic reddish patch above. Between origin of anal and caudal 5 equally distant black spots the first, second and third containing 3 white rounded organs, the fourth 2, and the fifth 4; an antorbital organ below nostril, a series of 4 organs underneath the cheek; 2 opercular ones, one behind the eye and one behind the maxilla, 2 or 3 on the gill membrane. Brownish operculum and belly silvery. A series of about 15–17 black spots between operculum and caudal . . . (Weber and the Beaufort, 1913, p. 137.)

This species is represented in the collection by No. 15984, a single, mutilated specimen, 26 mm long, collected by the Danish Scientific Expedition June 16, 1929, at Station No. 3731, VI, 119° 52' E. Long. 14° 37' N. Lat. about 60 miles NWW off Lubang Island, Mindoro, at a depth of 1,000 meters.

As far as is known this is the first locality record of *V. tripunctulatus* from Philippine waters.

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ILLUSTRATIONS

PLATE 1. SCALES OF PHILIPPINE ISOSPONDYLOUS FISHES

- FIG. 1. *Nematalosa nasus*, $\times 6$.
2. *Dussumieria hasseltii*, $\times 6$.
3. *Chanos chanos*, $\times 5$.
4. *Megalops cyprinoides*, $\times 3$.
5. *Dussumieria acuta*, $\times 6$.
6. *Thrissocles setirostris*, $\times 6$.
7. *Thrissina baelama*, $\times 6$.
8. *Scutengraulis mystax*, $\times 6$.
9. *Chirocentrus dorab*, $\times 6$.
10. *Scutengraulis hamiltonii*, $\times 3$.
11. *Elops hawaiiensis*, $\times 9$.
12. *Albula vulpes*, $\times 3$.
13. *Anodontostoma chacunda*, $\times 5$.

PLATE 2. SCALES OF PHILIPPINE ISOSPONDYLOUS FISHES

- FIG. 1. *Sardinella longiceps*, $\times 6$.
2. *Sardinella jussieu*, $\times 5$.
3. *Harengula moluccensis*, $\times 5$.
4. *Sardinella sirm*, $\times 5$.
5. *Sardinella fimbriata*, $\times 6$.
6. *Stolephorus commersonii*, $\times 6$.
7. *Clupeoides lile*, $\times 6$.
8. *Stolephorus indicus*, $\times 6$.
9. *Ilisha hoeveni*, $\times 6$.
10. *Sardinella perforata*, $\times 4$.
11. *Sardinella samarensis*, $\times 6$.
12. *Harengula dispilonotus*, $\times 6$.
13. *Sardinella melanura*.
14. *Stolephorus tri*, $\times 6$.
15. *Harengula tawilis*, $\times 6$.

PLATE 3

- FIG. 1. *Anodontostoma chacunda*; head, $\times 1$.
2. *Nematalosa nasus*; head, $\times 1$.
3. *Clupanodon punctatus*; head, $\times 1$.

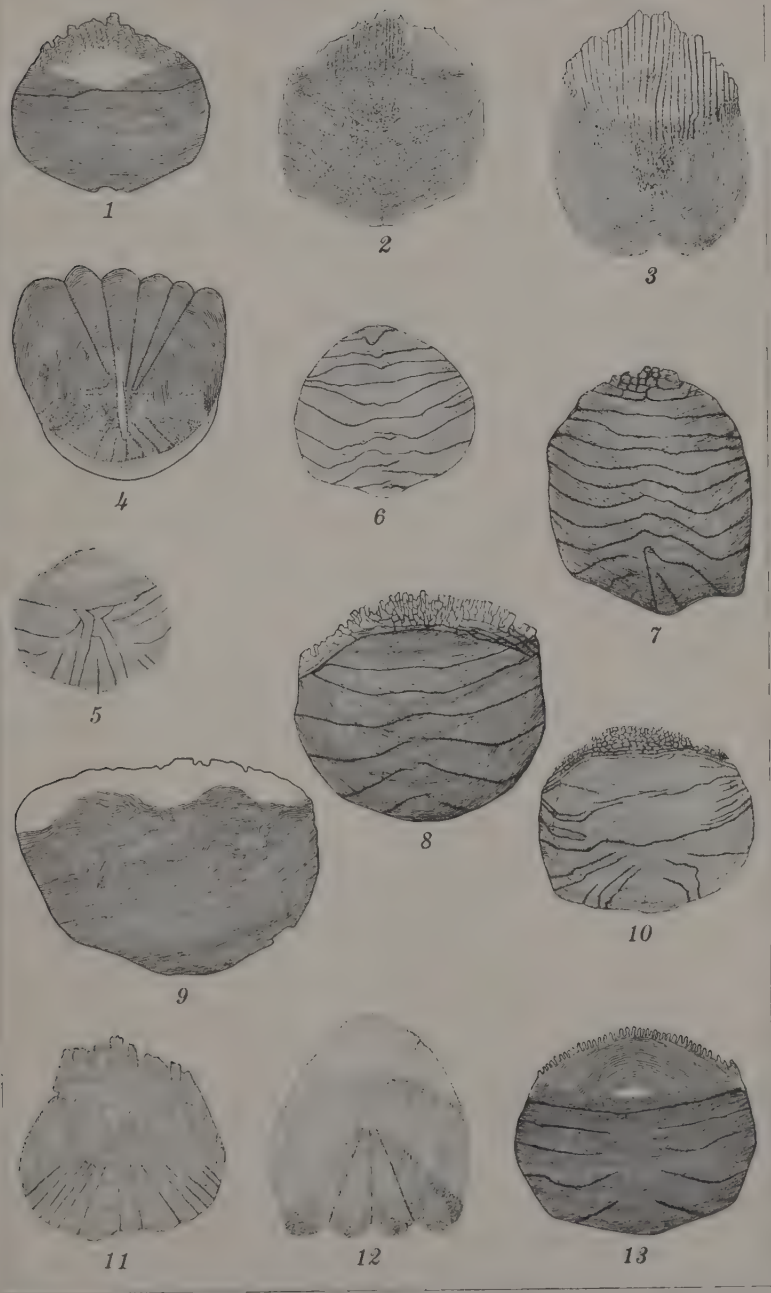


PLATE 1.

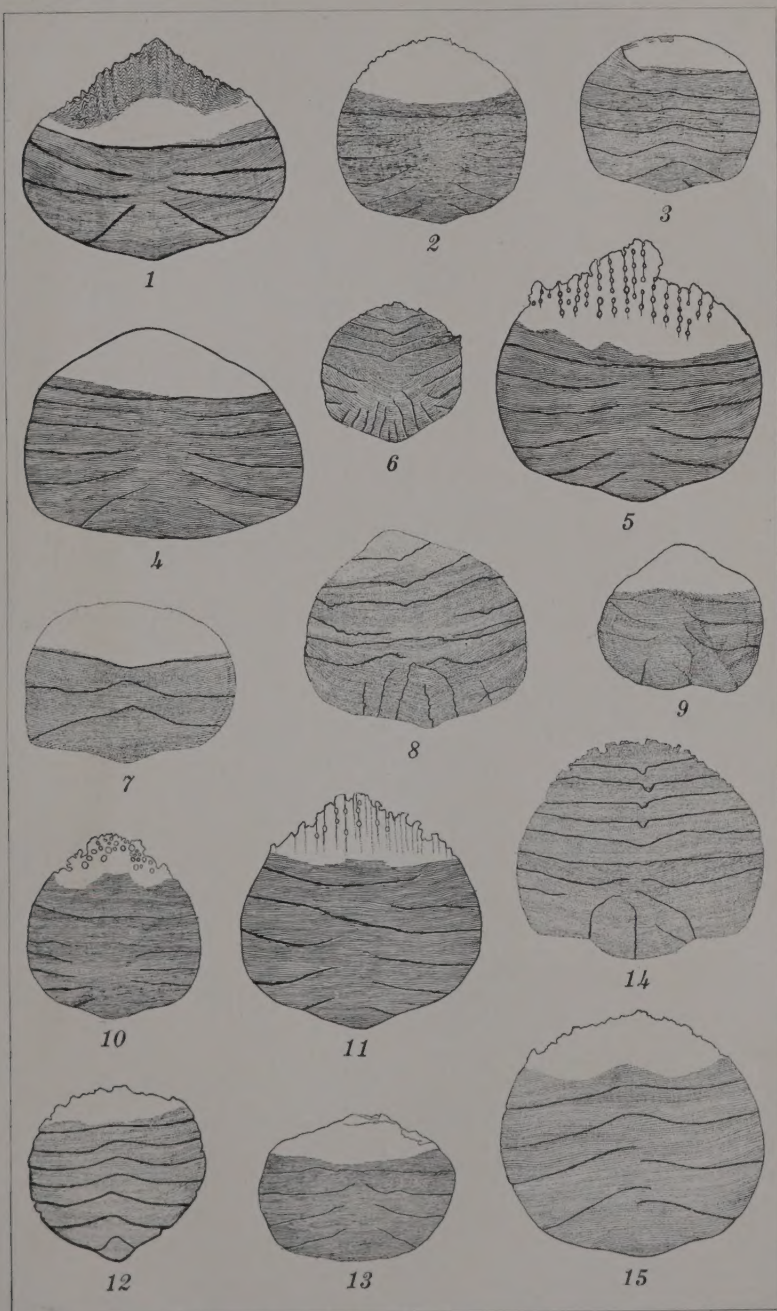


PLATE 2.

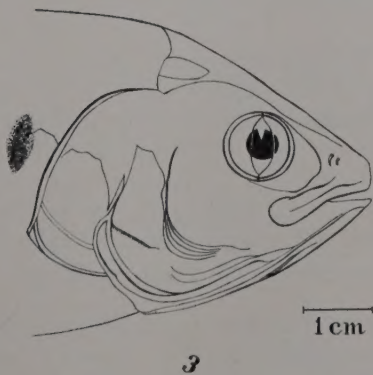
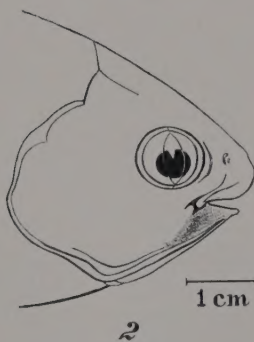
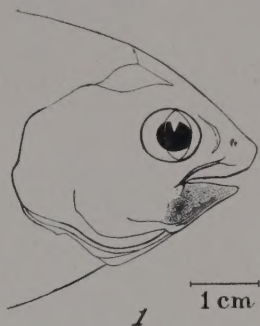


PLATE 3

